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THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S., &c.

VOLUME XIX.—1869.

LONDON:
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PREFACE.

THIS volume terminates with the five hundredth number of the "CHEMICAL NEWS," and we may, perhaps, at this juncture, not unfitly say a word or two concerning our enterprise.

The reader cannot fail to have observed that we have recently made several important improvements in the "CHEMICAL NEWS." We have striven to make it not only a chemical newspaper, but a STANDARD WORK OF REFERENCE. Besides the original and critical papers proper to a journal, we are now giving, under the head of "Chemical Notices from Foreign Sources," the titles of all the contemporary chemical papers published throughout the world, and abstracts of the more important of them. Moreover, the Index has been very carefully compiled, and made much more copious and available for ready reference. We may fairly state that the two half-yearly volumes of the "CHEMICAL NEWS" represent essentially, in extent of material and facility of reference, the *Jahresberichte der Chemie*; and, in fact, we may claim for the "CHEMICAL NEWS" that its annual issue is a handy Year-book of Chemical Science.

It is a matter of gratification to the Editor to find that the "CHEMICAL NEWS" has attained so large a circulation in America. There it is re-printed in monthly numbers, to which is added a supplement to chronicle any scientific matters pertaining specially to America. Our circulation, including that of the American reprint, has risen to about 10,000 copies of each issue. This fact we are constrained to note, since, in the majority of instances, the only rewards the man of science can ever secure are the appreciation of his labours by fellow-workers and the consciousness of having served mankind.

For more than a quarter of a century the "CHEMICAL NEWS" (with its predecessor, the *Chemical Gazette*), has faithfully recorded the progress of Chemistry and cognate sciences at home and abroad; so, in the future, our constant anxiety will be exercised to render it a still worthier representative of Chemical Science.

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THE CHEMICAL NEWS.

VOLUME XIX.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 474.—FRIDAY, JANUARY 1, 1869.

ACCURACY.

Accuracy and knowledge of detail are the great aims of modern scientific men. There may be much that is indefinite, but, when accuracy comes, every opposing speculation and supposed law or fact falls as hopelessly before it as that celebrated road to the skies which was felled to the earth by a well-aimed blow from Jack's hatchet. Speculation in its early meaning is seldom heard. Thought must stand on scientific ground and follow a scientific line; if it is diverted it must be at angles which accord with the logic of nature.

We sometimes like before looking at our own age to glance at that which is past. It is pleasant to associate ourselves with our brethren, however far separated. If we wish to know the history of our own thoughts we trace them back in our minds, and if we wish to know how the world learned to think we must look to the ages which preceded the building of our ideas. There is, however, another reason not so purely logical, but perhaps more powerful. There is a richness in these early thoughts because they have a tint of the eastern sun which never fades, and we shall admire their brightness whilst time lasts, or until that day when the poet comes who shall exhaust in his writings the delight which children have in the fields and the sunshine.

In early days of the world thoughts were not enchained by experiments, and great wide souls made boundless systems which endeavoured to include the infinite magnitudes that presented themselves to view in time and space. The warm colours were obtained from the fire in which they were smelted, although the heat itself has been quenched with an unheard hiss in the western seas. If we admire order, here is an idea stately and great; perhaps the formality, and, if we may add also, the imperial dignity, are among the early modes of seeking logical order and extreme accuracy. The Desatir is said to mention a system of the heavens in which each star reigns for a thousand years, and has besides one star for a prime minister; and when every heavenly body shall have gone through the two offices of minister and ruler one great heavenly period shall have been accomplished. Every year is made of days, which days again consist of one revolution of Saturn or nearly thirty years. Every year, therefore, was above 10,000 of our years. Precision in form was taken for accuracy. On this point it is to be feared that even chemists may err. Part of the above shows a desire to comprehend the infinite, and we do somewhat the same when we think of the most probable—if not well proved—central kosmic sun round which our own system revolves.

The classical ancients seemed to seek accuracy by a very different method, and, unable to comprehend the infinite any more than their eastern forefathers, they determined at least to throw away the indefinite or vague, and this they did by making the sayings and doings of the celestials as trivial and useless as their own. The reasoning faculty has little reverence, and when it cannot grasp the wonderful it throws it aside, for the same reason as the hard uncle left the babes in the wood.

The north, like the east, had no desire to diminish the wonderful, but, perhaps, when they talked of the lights of heaven being pursued by a wolf who would swallow up the moon, they meant no more by that great capacious throat than our own stern Carlyle means when he uses such an expression as "infinite abyss." They must, however, bear the blame of inaccuracy of words. The Greek mind reduces all wild solemnities to the most unromantic common place, and thereby brings us out of much folly into plain common sense. Hear the complaint of the moon in the second century. "My patience is worn out by the philosophers who are perpetually disputing about me—who I am, of what size, how it happens that I am sometimes round and sometimes full, at other times cut in half; some say I am inhabited, others that I am only a looking glass hanging over the sea, and every one seems to fit on me any notion they may have. They even say that my light is another's and stolen from the sun, not hesitating to set me and my brother in opposition. For it is not right that they should call the sun a stone or a red-hot clump." It was centuries before this that the sun had been called a red-hot stone as large as the Peleponesus. We in our time cannot differ far in principle from this view, and it has taken very long indeed to make steps in accuracy regarding the constitution of the heavenly bodies; still we tend to it. It would seem as if the world had always a large amount of matter standing for facts. We take pleasure in looking at an old chemical work, "Dictionnaire de Chimie," of the "Encyclopédie Méthodique," begun in 1786 on such a scale that the first volume, quarto and double columned, and of 773 pages, goes only the length of the word "Airelle." Then knowledge was actually as bulky as now, although, perhaps, no sentence is written with accuracy. They had enough to say to fill their minds;—nay, we may go very much farther back, and for mere curiosity let us quite at random take up Pliny, who knew everything of his time in a rough way, and let us ask the cure for any common pain—say headache—we are not disappointed. The remedies are abundant. The heads of slugs or wool grease, or the bones of a vulture's head, or its brains mixed with oil and cedar rosin and applied to the head and nostrils; more are given equally promising, and some pretending to great accuracy, such as "the small bone from the head of a snail that has been found between two cart ruts, and after being passed through a gold ring with a piece of ivory, is attached to the patient in a piece of dog's skin, a remedy well known to most persons, and always used with success."

The whole course of thought is now changed among men who have received even a tinge of science, but the spirit of old times is not quite forgotten. There must be many men who remember in early days that it was enough to bring forward a good quotation when they wanted a proof, and there must be many who know minds incapable of seeking any other proof. There are in Europe superstitions exactly of the kind mentioned, some of them blended with forgotten knowledge, some wholly fantastic; it is the business of science to remove them and bring more accuracy. Modern astronomy is built on a basis of very careful observation and calculation, but we have never been able to find that modern astrology had even a semblance of a basis. It is even far behind the ancient in its attempts at proof. It seeks none, whereas in the East it is said that star watchers sat carefully observing the heavens whilst others gave notice of the birth of a child, in order to know exactly at what aspect of the skies it came into the world. This would produce a science founded on fact, or it would put an end to the whole. Without a trace of experiment, men wealthy enough to promise large sums come even now to astronomers to know the course of future events, but they will not give the money to a good tutor to relieve them of their ignorance.

It is difficult to measure the distance between this merchant consulting the astronomer, and the astronomer himself, who has a difficulty in making his visitor understand that he cannot read the future. Let us say the difference is two thousand years. Let us also pause a moment to consider the progress made by the astronomer in two thousand years. Perhaps the first man that counted by seconds was one who found the pendulum to be his own heart—a heart quietly beating after the violence of youth was over, sixty times a minute. The period of one beat has become for mankind a symbol of shortness; it is a length of time passing too rapidly to be calmly surveyed, and to speak of the movements in the sky to such accuracy was not to be thought of. There was no mode of measurement. Now the ear itself has become critical beyond the heart, and it dares to measure to one-tenth, whilst the intellect, with a refinement beyond its own full comprehension, divides the same period into a million, and the strange laws of nature placidly permit that mechanism shall be formed for the purpose. The man of the dark past, although he is living now amongst us, may have heard that from the great distances in space we see in stars that which has existed many years ago, and may think that we have only to turn the telescope and, by looking the other way, see equally far into the future. We have sympathy even with him, and we too would like to know the future of chemistry and even of man.

But we are among chemists and not astronomers, although when we look far back chemistry offers us few illustrations. Since we first took up a piece of earth and said to ourselves "of what is this made?" we have a long line of men, each striving to be more accurate than his neighbour. We do often wish that we could take up a history of these later men, written not merely in English but by Englishmen who had read and weighed everything for themselves. For our facts we must go either to the originals or to the Germans. We find in these rich volumes by Kopp abundance of matter well weighed, perhaps with as much justice to Englishmen as they could do themselves, but we should like to see it written with a warm heart towards our fellows, seeking out every corner as justice alone cannot, but as kindness only can. We turn to France and there we find a history truly original also, but with a name that sounds surely German—it is Hoefer. Well, we cannot blame them: we are thankful.

We cannot see the tendency towards exactness and clearness better than by taking a chemist's view. Air was once the soul of the world, it was the life of man, it was a spirit including intellect, it was a ghost, it was capable of turning into water, which again became earth, and it was in itself nothing material, and had no weight or substance. Now it has fallen into the ranks of ordinary things, although not less wonderful. It has been divided into parts, although unseen. This very spirit of the world has been dissected, and chemists treat it without reverence, measuring it out in tubes or weighing it on balances. Now we can scarcely tell how various its composition. It has two principal parts, but a third was soon added, whilst a fourth, under the name of ozone, has been followed by the scent for many years—we may even say since those ancient days when the smell was observed after violent lightning. Now we have plants and animal diseases almost endless, and strange influences accompanying every wind. These by degrees the scientific enquirer is hunting down, and preparing for the world new museums in nature where we shall see, by the aid of magic eyes, forms of disease lurking around and capable of being successfully attacked instead of insidiously entering and finding no one to struggle against them. The air has been, and will long be a study worthy of the greatest and the most acute, but the progress made is a great triumph, and shows that scientific men in many departments are reasoning, on the whole, rightly and fairly, gaining a victory over the world.

We may say that all organic matter comes from the air, the trees, and the lower animals, and man himself; and when we have viewed this proof which chemistry has made we almost return to the original idea that the air is the life of the world, not by general and vague reasons but by careful analyses. Out of air we may form or see formed by natural means thousands of bodies, each varied in in its structure as we can prove, although air itself is invisible; and out of it will come many thousands more—movements of unseen bodies, directed by unseen forces, and observed by unseen minds. It is to this that we have come by accuracy to a world that was as unknown as if it were in Saturn, whereas we are in its midst and the scales of our eyes only want removal to shew us the irresistible intelligences at work.

The wide and hasty flights of thought are past in many departments. The workers must walk softly. Our trail is not the broad foot of the elephant on the mud, but the slightly displaced leaf of the forest. With patience the chemist watches the drops from his filter and walks up and down on guard; with patience he observes that one-thousandth of the weight has been lost and that he ought to have lost less; he begins again. We do not wonder at Professor Rose being excited when a courtier walking about in his laboratory touched with exquisite forefinger a transparent precipitate of alumina on a filter. Stateliness of manners was forgotten. The chemist seized the offending finger and never ceased to wash it with a jet of water till the earth was all returned to the funnel; nor could he venture to explain, since the jet was driven by his own mouth and swollen cheeks.

The idea of cleanliness in all its accuracy is known only to chemists. When preparing a substance for analysis is there any trouble that we avoid if we can aid success. What! in a vile laboratory? Yes; no foul air must touch these bodies. Air, that which the most sensitive persons would consider sweet, would be poison. The slightest trace of carbonic acid or moisture, things found in all breezes, would make some analyses imperfect. We can well remember when in that stage of learning when sulphur and hydrogen are so much employed for metals we rushed forward to seek advice, but were driven back from the sanctum by the usually most urbane and pleasant friend. What could that mean? he was preparing a silver salt in order to obtain an important atomic weight. We are obliged to use not only pure air, but sometimes artificial atmospheres, and sometimes the entire absence of atmosphere. As to analysis generally, most chemists have seen in their own day the rise of the methods of Fresenius. It was no easy matter to learn from that of Rose. The information was great, but the system deficient. Now the details and system of Fresenius seem to form an embodiment of logic itself, and if any one learns them he must have learned to reason in such a way that he will

gain a great superiority over his former self. Every step carelessly made shews itself in material mistakes; the student must reason closely to keep his solutions correct. He cannot go with mere enthusiasm and boasting long. His own results bring him the greatest reproaches, his experiments silently humble him, and he is laughed at by forces that he cannot avenge.

We see the value of accurate work in Berzelius perhaps more than in any man. He built up inorganic chemistry, and if any man follows his work in organic departments he will learn to wonder at its accuracy. He worked as if the eyes of posterity were on all his movements, and he seemed to be able to do his enormous labours by making few blunders. There is no chemist from whom the young can learn so much of the art of working long and honestly. We modify his structure, but it was said by one, himself a great man, "Berzelius is the greatest chemist that is, or that was, or that will be."

We remember sitting with an old philosopher, when he said "Would you like to see the atoms of Epicurus, out of which the worlds were made—true star-dust?" Who would have said no? he brought a little bottle of meteoric dust—but we must not describe it; he will do it, or has done it. We thought of these atoms now visible to a microscope but still divided by the chemist in many portions, and long after the finest microscope can aid the finest eye the chemist goes on dividing, and with a certainty which is absolute.

It was our wish to shew that science is gradually making its devotees the representatives of care and accuracy. We have scarcely space to carry out the plan fully, but chemists are accustomed to such a variety of occupations that they can readily finish this article for themselves. It is a fine quality that of uttering undeniable truth. Let us not lower that position but rather magnify our office. Let our words suit the facts with an accuracy equal to that with which the facts themselves can be ascertained, and in a world of wavering and changing let us show that there is a class of facts to be found upon which reliance can be placed so far that we may be certain they will never change. In common affairs a mistake may have but a short life, but in the study of nature an imperfect observation may cause infinite trouble to thousands. The increased study of science will promote exact observation and greater love of truth among men, and will produce a race that will either absorb the worthless residuum or drive it hence into the unknown and unseen.

ON A MODIFICATION OF THE METHOD OF ASSAYING SILVER COMPOUNDS IN THE WET WAY.

By M. STAS.

The mode of testing in the wet way in order to fix the standard of silver substances, as established by Gay-Lussac, is open, under certain conditions, to a source of error, arising from the solubility of chloride of silver in the very liquid to which its origin is due. This solution, whatever its mode of production may be, is precipitated equally by a decimal solution of silver and by chlorhydric acid. The extent to which this precipitation ensues is uncertain. At the ordinary temperature, there may be a variation of from one to six thousandths in 100 c.c. of the liquid. Practically, it is quite possible, while still preserving the simplicity of the wet method, as invented by Gay-Lussac, to substitute a bromide for a chloride in precipitating silver, and thus remove absolutely those anomalies which have been observed to be attendant upon the use of a chloride or of chlorhydric acid.—*Comptes Rendus.*

ON THE ESTIMATION OF TITANIC ACID.

By DAVID FORBES, F.R.S., &c.

The results of numerous analyses of rocks and of the products arising from their disintegration and decomposition have proved thoroughly confirmatory of the observations by Mr. Riley brought forward in his valuable paper "On the General Occurrence of Titanic Acid in Clays, &c.," published in vol. xv. of *The Journal of the Chemical Society*; and having myself, in the course of these investigations, paid considerable attention to the various processes employed for determining the presence and amount of titanic acid contained in mineral and metallurgical products, it is considered that the following remarks upon this subject may probably be of use to the analyst:—

As it still appears to be the common opinion, that, in the process of the analysis of mineral silicates, titanic acid when present does remain altogether, or in greatest part behind along with the silica which has been separated from the bases, it seemed, therefore, desirable to ascertain how far this actually was the case, and also whether any definite ratio existed between the amount of the insoluble titanic acid which remained behind with the silica and that which was taken up by the acid solution.

The result of the examination of several clays and rocks containing this acid, served to show that a very considerable amount of the entire titanic acid present in the substance analysed, did really enter into solution, and consequently that a material error would occur in the statement of the results of the analysis, if this amount was neglected, and merely the quantity remaining behind with the silica was assumed to represent the total percentage of titanic acid present in the substance under examination.

A single example will suffice to show that this is actually the case. Upon analysis, at the request of Mr. George Maw, F.G.S.,* of a red clay, which formed a stratum of from 7 to 8 feet in thickness, occurring at about the middle of the Shropshire coal measures at Calcotts, near Broseley, the following percentage composition was found:—

Silica, combined	29·71	64·06
,, free	34·35	
Titanic acid, insoluble	0·37	0·62
,, soluble	0·25	
Alumina		20·60
Sesquioxide of iron		6·84
Protoxide of iron		0·32
Protoxide of manganese		0·09
Lime		0·12
Magnesia		0·04
Potash		0·91
Soda		0·44
Water, with traces of organic matter		5·85
		99·89

From these results it will be seen that above 40 per cent of the entire amount of titanic acid present in the clay had entered into solution, and was afterwards thrown down by ammonia (which precipitates titanic acid completely) along with the alumina and sesquioxide of iron obtained together in the course of the analysis.

The method employed in separating the titanic acid from these substances, was simply to dissolve the precipitate of alumina, sesquioxide of iron, and titanic acid in dilute sulphuric acid, to neutralise a considerable portion of the excess of sulphuric acid by solution of caustic soda, then to add a few drops of nitric acid, which prevents the titanic acid subsequently precipitated, from carrying

* *Vide Quarterly Journal of the Geological Society*, vol. xxiv., p. 354, 1868.

down with it more than a trace of sesquioxide of iron, and after still further dilution with a large excess of water, to boil for some time until all the titanic acid is precipitated in the insoluble form.

The insoluble titanic acid remaining with the silica was extracted from it, by boiling the silica in a platinum crucible for some time, with concentrated pure sulphuric acid, allowing it to cool, and then pouring the whole rapidly into a large excess of cold water so as to avoid any considerable rise in temperature of the solution; after filtration from the insoluble silica, the solution was nearly neutralised by soda, a little nitric acid added, and the titanic acid precipitated by boiling as before.

According to Marignac, titanic acid is precipitated from its solution in concentrated sulphuric acid after dilution with from five to six times its volume of water upon boiling, but it was found safest to neutralise a large portion of the excess of the acid by soda before boiling the solution, which, after filtration, was, upon subsequent testing, not found to retain any appreciable amount of titanic acid.

The results of various experiments, not only proved that the proportion of titanic acid dissolved, amounted to a very large percentage of the total titanic acid contained in the silicate, but also showed, especially when but very little titanic acid was present in the mineral or rock, that the amount which entered into solution might occasionally be much greater than that which remained behind with the silica. In all analyses, therefore, it becomes a matter of necessity to determine both the soluble as well as the insoluble titanic acid, in order to obtain correct results both as regards the amount of titanic acid present or also to obtain the true percentage of the silica, alumina, and sesquioxide of iron. Even when the total amount of titanic acid in a mineral has been determined by the usual process of fusing it with from eight to sixteen times its weight of bisulphate of potash, or, still better, bisulphate of soda (since the soda compounds are much more soluble), and afterwards boiling the very dilute solution of the fused mass in cold water, until all titanic acid is precipitated; there still remains the difficulty of knowing how much of the titanic acid thus found should be deducted respectively from the weight of the silica or from that of the mixed precipitates of alumina with sesquioxide of iron.

In these cases I have found the following mode of procedure convenient:—The mineral, clay, or rock reduced to an impalpable powder, is placed in a proper sized platinum crucible, and made into a very liquid paste with pure concentrated sulphuric acid; the whole is then kept for some hours exposed to a temperature sufficiently high to cause it to emit slight fumes of sulphuric acid without making it boil or spirt. By this means the entire amount of titanic acid present, combined or uncombined in the substance, appears to be converted into the soluble modification and is taken up by the sulphuric acid.

The whole is now allowed to become quite cold, the contents of the crucible is then discharged into a beaker glass containing so large an excess of cold water that no rise of temperature need be apprehended, and the crucible itself washed out with cold water. This solution is now filtered from the insoluble matter, consisting of silica along with any undecomposed silicate which may remain unacted upon by the sulphuric (and if much lime, strontia, or barytes, is present, some sulphates of these earths) acid; this should be washed, first with cold and then with hot water. The filtrate is now nearly neutralised by caustic soda and boiled for a considerable time, occasionally adding more water as evaporation takes place, so as always to keep the solution very dilute, until all the titanic acid has been precipitated.

Should much iron be contained in the solution, a little nitric acid should be added to the filtrate previous to boiling, in order to prevent the titanic acid carrying down with it more than a trace of sesquioxide of iron.

The titanic acid thus obtained usually retains some sulphuric acid, and should be heated with the addition of a little carbonate of ammonia to volatilise this acid; after ignition the titanic acid usually is of a light yellow colour, but should it present a deep red appearance, due to sesquioxide of iron carried down along with it, it should be fused with bisulphate of potash or soda, the fused mass dissolved in an excess of cold water, a few drops of nitric acid added, and the solution boiled, when it will be obtained nearly colourless or of a faint yellow tinge.

The insoluble matter obtained after treatment of the original substance may now be fused with carbonate of soda and potash as usual in the analysis of an insoluble silicate, taking care, of course, to add to its solution the filtrate from which the titanic acid has been precipitated by boiling.

In some cases, where but traces of lime or other element which would form a sulphate insoluble in water or solution of sulphate of soda or potash are present (zirconia thorina, &c.), the analysis may be made by fusing the mineral with about ten times its weight of bisulphate of soda or potash, (preferably the former, from the easy solubility of its fused product) dissolving the mass in cold water and filtering it from the insoluble silica, which, after washing, first with cold and then with hot water, may be weighed after ignition as usual. From the filtrate the titanic acid is precipitated by boiling, some nitric acid having previously been added in case oxide of iron is present in any quantity, and after filtration the solution can be used for determining the bases, alumina, iron, magnesia, &c., as usual.

In estimating the amount of titanium or titanic acid in samples of cast or wrought-iron this substance has usually been sought for in the residue insoluble in acids, but the following experiments also prove that such a procedure cannot be relied upon as furnishing correct results.

A sample of cast-iron produced from smelting a titaniferous magnetite from Gullaxrud, in Norway, in a charcoal blast furnace, the complete analysis of which ore is given in the Chemical News, vol. xviii., No. 471, p. 276, was taken, and 251·59 grains in small fragments dissolved in nitrohydrochloric acid; the insoluble residue was collected on a filter, incinerated, digested with sulphuric acid, and the titanic acid present determined as before described, when it was found to amount to 0·52 grains, equivalent to 0·207 per cent titanic acid or 0·126 per cent titanium.

The filtrate was now neutralised carefully with ammonia, and then a slight excess of ammonia added, so as to cause a small permanent pecipitate of sesquioxide of iron to be formed, which was then filtered off from the ferruginous solution and washed. This precipitate, which contained all the titanic and phosphoric acid present in the iron, along with an excess of sesquioxide of iron, was now dissolved in a little very dilute sulphuric acid, some nitric acid added and the solution boiled; an immediate precipitate of titanic acid was formed which, when determined, amounted to 0·14 grains, or 0·056 per cent, equivalent to 0·034 per cent titanium. The examination of this cast-iron resulted in showing that it contained 0·207 per cent titanic acid in the insoluble form, and 0.056 per cent titanic acid in the soluble form, or a total of 0·263 per cent titanic acid, and that, consequently, more than 20 per cent of the entire titanic acid had been dissolved of the acids employed in the analysis.

Another sample of cast-iron produced from smelting the titaniferous magnetite from Christine Mine, near Krageroe, in Norway, was also examined with the same object in view. In this case 104·26 grains of the cast-iron in fragments were dissolved in nitrohydrochloric acid, and left an insoluble residue which, after incineration, weighed 2·47 grains; this was, as in the last case, digested in concentrated sulphuric acid; the titanic acid, which was determined as before described, weighed only 0·02 grains. The acid filtrate was then treated with ammonia, so as to precipitate a small amount of the sesquioxide of iron along with

any titanic acid contained in the iron, and this latter determined as in the former case, amounted to 0·03 grain.

The result of this experiment shows, therefore, that this cast-iron contained a total of only 0·048 per cent titanic acid (equivalent to 0·029 titanium) of which 0·019 per cent remained in the insoluble residue, whilst 0·029 per cent had been dissolved in the acid solution, confirming the previously arrived at conclusion, that when a very small amount of titanic acid is present in a substance, the major part of it is often, if not always, to be found in the solution, and not in the insoluble residue.

I have not been able, as yet (although I have made several experiments for the purpose), to prove satisfactorily that titanium alloys with iron, but the analysis of various samples of cast-iron, wrought, bar, and steel smelted from ores containing titanic acid in considerable quantity, appear rather to indicate that the small amount of titanium which they really do contain, is mechanically associated with the iron probably in an oxidised state, than present as a true alloy with the iron itself.

ON THE

IMMEDIATE ANALYSIS OF METEORIC IRONS.*

By STANISLAS MEUNIER,
Aide Naturaliste at the Museum of Paris.

THE numerous researches hitherto made with regard to the composition of meteoric irons have demonstrated in these extra-terrestrial bodies the existence of the following compounds:—

1. The *general mass* which is formed by the union of several alloys in which iron and nickel are predominant, and which we will designate under the name of *nickeliferous iron*. Among the substances comprised in this mass, the *kamacite*, the *tænite*, and the *plessite* will be specially mentioned.
2. The *carburetted iron* comprising the *Campbellite*, and the *Chalypite*, recognisable by the carboniferous deposit which they give under the action of acids.
3. The *sulphuretted iron*, or *troïlite*, which appears in nodules and in veins.
4. The *phosphide of iron and nickel*, or *Schreibersite*.
5. The *graphite*.
6. The *external crust*.
7. The *stony particles*, or *crystals*.
8. The *gases* retained by occlusion (Graham).
9. Several compounds which are only met with exceptionally, as *chromite* and *protochloride of iron*.

The last may even have a terrestrial origin, according to the opinion of Mr. Shepard.

I have recently tried to separate those different substances, and I have submitted each of them to a special examination. My results are, for the greatest number, the fixation of their chemical formulæ, and I think they will be received with interest.

I. NICKELIFEROUS IRON.

The first problem to be solved is the separation of the different alloys which are mixed in the general mass of meteoric irons; but it is necessary first of all to prepare that general mass freed from other substances which I have already named.

For this end, the iron being reduced to powder by means of a hard file, the metal is thrown into pure potash fused in a silver crucible. Instantaneously the alkali, hitherto limpid, becomes troubled by the presence of little grey flakes, which are the result of decomposition of troïlite, schreibersite, stony matters, &c., and consist of oxide of iron.

When this decomposition of foreign substances is complete, the alkaline mass is cooled and treated by water. All the potash is carried away with the greatest part of oxide of iron. The remainder of this oxide is easily dissolved by strong nitric acid, in which the iron becomes passive.

The metallic powder is then well washed and dried; it is exclusively formed of nickeliferous iron, containing, however, in certain cases, a small proportion of carburetted iron.

Chemical methods have not yet completely succeeded in separating the alloys mixed in the nickeliferous iron, and, after several essays, I have been obliged to employ a physical process.

My experiments have been made with the meteoric irons of Caille (France), and of Charcas (Mexico).

First of all, it was necessary to determine with exactness the number of constituent compounds contained in the nickeliferous iron of those masses. For that purpose a small polished plate of the iron of Caille was heated with precaution and uniformity. This operation, of which the first idea is due to Widmanstætten, drew, by the unequal oxidability of the different *immediate principles*, a yellow net upon a blue ground. There were also several portions of an intermediate colour, clearly limited like the others, and occupying the spaces bounded by the crossing of the yellow lines.

An attentive examination showed that the three metals were reduced to two; the third being formed by the mixture of the others, reduced to alternate thin sheets.

The blue iron is formed by the kamacite, and the yellow by the tænite.

Their separation was very difficult on account of the analogy of the chemical properties of the two metals. If it is true that the kamacite is more soluble than the tænite (and this is proved by the experiment of Widmanstætten), it is true also that the difference is too small to permit a separation. When all the kamacite is dissolved, only a very small proportion of the tænite remains; the greatest part being dissolved also.

To effect the separation, I heated some metallic powder placed upon a glass plate. The particles formed by kamacite become blue, whilst the particles of tænite are yellow. Then the two sorts of grains are separated with a pincer.

After about fifteen operations, I collected 2 grammes of kamacite, and 0·5 grammes of tænite, that I could chemically examine.

The Charcas iron gives the same results.

The specific weight of tænite is 7·380. Its analysis has given me the following numbers:—

Iron	85·0
Nickel	14·0
	99·0

which agree with the formula Fe_6Ni.

The kamacite has a specific weight equal to 7·652, and I have found for its composition—

Iron	91·9
Nickel	7·0
	98·9

Its formula is $Fe_{14}Ni$.

On this subject it will be remarked that in admitting, according to the numbers given above, that the Caille iron contains 80 per cent of kamacite and 20 per cent of tænite, its elementary formula will be expressed by

$$Fe_6Ni + 4(Fe_{14}Ni) = Fe_{62}Ni_5,$$

which gives numbers very near those which M. Rivot has obtained in the elementary analysis of that mass.

The above formula gives—

Iron	91·4
Nickel	8·6
	100·0

* Communicated by the Author.

And M. Rivot has found, in two analyses—

Iron	92·3	92·7
Nickel	6·3	5·6
	98·6	98·3

All meteoric irons are not so simple as those of Caille and of Charcas. There are some which contain with kamacite and tænite a certain quantity of other metallic alloys.

One of the most important of these is the plessite, which abounds, for example, in irons of Jewell Hill (North Carolina), and of Oldham (Kentucky). I have isolated it by the same method which had served for the preceding substances.

The plessite offers a density of 7·850, and I think that its composition is well represented by the formula $Fe_{10}Ni$, but I have had so little of this substance that I cannot make a completely satisfactory analysis.

Amongst the other alloys of iron and nickel, I will name the *octibbehite*, whose composition is exceedingly remarkable for the large proportion of nickel (59·60 per cent). Its density is only equal to 6·854. The meteoric iron of Octibbeha (Mississipi) seems to be entirely formed of that alloy; this results from the studies of Mr. Taylor.

II. Carburetted Iron.

Several meteoric irons give, by the action of acid, a black deposit, more or less abundant, consisting of carbon. This carbon comes from a compound of which the composition is analogous to that of steel.

In this point of view, the meteoric iron of Campbell (Tenessee) will be specially mentioned. It gives by analysis a metallic matter, formed by the union of 1·50 per cent of carbon with 97·54 per cent of iron. I propose for it the name of *Campbellite*; its density is 7·05.

Mr. Shepard gives the name of *chalypite* to a carbide of iron which Forchammer has noticed the presence in the meteoric iron of Niakornak (Greenland), and of which the formula is CFe_2. I have had no opportunity of seeing this substance, which does not exist in the Museum of Paris.

III. Sulphuretted Iron.

To prepare the sulphuretted iron, or *troïlite*, in a complete state of purity, we may have recourse to the metallic powder. This powder is placed during a quarter of an hour in a boiling concentrated solution of sulphate of copper. All the nickeliferous iron is dissolved, and, by decanting and washing, a mixture of metallic copper, troilite, schreibersite, graphite, and stony matter is obtained.

A small quantity of concentrated nitric acid dissolves the copper. The magnet, acting under water, is the best means to separate troïlite and schreibersite (which are magnetic) from graphite and stony matter. Lixiviation, in conclusion, can be employed to isolate troïlite from schreibersite.

When the iron under experiment contains only a small quantity of troïlite, it is preferable not to make use of nitric acid, which always dissolves a little of the desired substance. In these cases I dissolve the nickeliferous iron by means of bichloride of mercury. The protochloride of mercury is carried off by a solution of chlorine, and it is easy to separate the metallic mercury.

Besides, it is always better, when possible, not to extract troïlite, from no matter what part of iron, but from the cylindroïd nodules in which the substance has concentrated itself. Thus the sulphuretted iron contains only some graphite and stony matter, which can be got rid of by the action of the magnet. It is correct to say that this troïlite is one of the most characteristic principles of meteoric iron. Notwithstanding, its crystalline forms have not yet been recognised, and there is some doubt about its chemical composition.

The first chemists who examined it considered it as a variety of Breithaupt's pyrrhotine, and gave to it the formula Fe_7S_8.

But Mr. Lawrence Smith concluded from his analysis of the sulphur of the iron of Tazewell, that it has the composition of a protosulphide FeS.

Notwithstanding, he continued to give it the name of pyrrhotine, and thus a great confusion was introduced into science. Besides, Mr. Smith rested both upon the results of his own experiments and upon those obtained by several chemists in the examination of other troïlites, his conclusion was not admitted, and the existence of true crystalline magnetic pyrites, in meteorites will increase the doubts.

The distinction between the troïlite (or Mr. Smith's pyrrhotine) and the Breithaupt's pyrrhotine, is not so clear as it seems at the first view. The difference of composition is very slight, and the physical properties are very similar.

I have had lately occasion to analyse several specimens of troïlite taken from the meteoric irons of Charcas and of Toluca (Mexico), and the numbers which I have obtained have given me reason to think that the mineral in question is nearer to magnetic pyrites than to protosulphide of iron.

Before giving the results of my analyses, I will call attention to a reaction which seems to me calculated to permit in all cases to distinguish the protosulphide from the magnetic pyrites, and, *à fortiori*, from compounds which are more rich in sulphur.

When protosulphide of iron is placed in a solution of copper, it precipitates this metal almost like iron itself; pyrrhotine, on the contrary, does not produce such a precipitation. The protosulphide obtained by the action of sulphide of ammonium upon iron salts produced the same effect as the substance of exactly the same composition prepared by igneous means.

This being well established, I put several troïlites into a solution of copper, and I did not observe any precipitation; the troïlite is then very like the magnetic pyrites in this respect, and we may arrive at the same conclusion relatively to the chemical composition.

In fact Mr. Smith has based his formula, FeS, upon his analysis of Tazewell's troïlite, which gave him :—

Iron	62·38
Nickel	0·62
Copper	trace
Lime	0·08
Silica	0·56
Sulphur	35·67
	99·31

But these numbers show that the substance employed in his experiments was very impure.

I have begun to purify the troïlite by the process described above, and I have thus obtained a matter of which the specific gravity was 4·799. Its colour was bronze, and its analysis gave me :—

Iron	59·01
Nickel	0·14
Copper	trace
Sulphur	40 03
	99·18

I will remind the reader that the formula Fe_7S_8 requires—

Iron	60·4
Sulphur	39·6
	100·00

The Charcas troilite, previously purified, gave me—

Iron	56·29
Nickel	3·10
Sulphur	39·21
	98·60

Its density is equal to 4·78.

The normal presence of nickel makes of troilite a species distinct from pyrrhotine, and its true formula is $(Fe.Ni)_7S_8$.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 17, 1868.

Dr. Warren de la Rue, F.R.S., President, in the chair.

The minutes of the previous meeting having been read and confirmed, and the usual lists of donations and of visitors having been announced, the following certificates were read.

For the first time—Mr. J. J. Field, Highgate, Mr. H. W. Kearns, Accrington, Mr. E. L. Barret, 44, Lawford Road, London. For the second time—Mr. F. W. Hart, Mr. E. K. Muspratt, Mr. S. Williams, Mr. J. F. Allen. For the third time—Mr. T. Rowan, Mr. W. W. Stoddart, Mr. J. Hughes. The three last-named gentlemen were then balloted for and were duly elected.

The Secretary then read a paper "*On the Isolation of the Missing Sulphur Urea*," by J. Emerson Reynolds, Member of the Royal College of Physicians, Edinburgh, Keeper of the Minerals and Analyst to the Royal Dublin Society, &c.

Just as cyanate of ammonium under the influence of heat yields urea, so sulphocyanate of ammonium under similar circumstances should yield sulphur urea—

$$\left.\begin{matrix}CN\\NH_4\end{matrix}\right\}O = \left.\begin{matrix}(CO)''\\H_2\\H_2\end{matrix}\right\}N_2$$

$$\left.\begin{matrix}CN\\NH_4\end{matrix}\right\}S = \left.\begin{matrix}(CS)''\\H_2\\H_2\end{matrix}\right\}N_2$$

The probability of this reaction induced Liebig, Völckel, and some other chemists to study the action of heat upon the sulphocyanate, but the results did not agree with their expectations.

More recently Dr. Hofmann* described a number of substitution derivatives of sulphur urea, but he did not succeed in isolating the urea itself. He appears to have regarded sulphocyanate of ammonium as the true sulphur urea, in spite of its saline constitution.

The author, in considering the points of similarity and of difference between the cyanate and sulphocyanate of ammonium, became convinced that the greater stability of the latter compound was the chief bar to its molecular rearrangement.

The temperature of 100° C., which effects the conversion of the cyanate into urea, has no effect upon the sulphocyanate, which, however, decomposes easily at temperatures above 180° C. The author therefore tried the effect of a regulated temperature upon the latter salt, and was rewarded by the isolation of the missing sulphur urea. He proceeded in the following manner:—

About 500 grammes of the well-dried salt were heated to 170° C. for two hours by means of an oil bath, the author remarking incidentally that the true fusing point of the salt was found to be 159° C., instead of 147° as usually stated.

The mass was allowed to cool to 100° C., and was then treated with its own weight of water at 80° C. When the whole was dissolved, the liquid was filtered through a plug of cotton wool for the purpose of separating a small quantity of black substance, and was then allowed to stand until an abundant crop of fine long silky prisms of the new compound had formed.

After several recrystallisations from boiling water, the urea was obtained in a state of purity, and gave on analysis numbers which led to the formula—

$$\left.\begin{matrix}(CS)''\\H_2\\H_2\end{matrix}\right\}N_2$$

Some difficulty was experienced in the determination of the carbon in consequence of the large proportion of nitrogen and sulphur present. It was found advantageous to introduce into the combustion tube, after filling with chromate of lead in the usual manner, a porous copper rod, prepared by rolling fine gauze so closely as to leave no central tube. This rod was heated, first in air and then in hydrogen, in the usual way, and was then made to fit closely into the combustion tube. It was found to reduce completely the nitrogen oxides formed during the combustion.

The new substance crystallises in long fine needles or in short thick prisms, in either case belonging to the trimetric system. It is non-deliquescent in moderately dry air, is very soluble in water and alcohol, and sparingly so in ether. The solution froths slightly on agitation, has a neutral reaction, and a somewhat bitter taste. Heated with water in a sealed tube for some hours to 140° C., it is reconverted into sulphocyanate of ammonium, as may be shown by the iron test. The urea does not give a colour reaction with the test. Heated with hydrate of potassium in a sealed tube, it is decomposed in the following manner:—

$$(CS)''H_4N_2 + 2H_2O = 2NH_3 + CO_2 + H_2S.$$

Hydrochloric and sulphuric acids effect a similar change.

The substance fuses at 156° C. Heated to a higher temperature in a closed tube it evolves sulphide of ammonium, carbonic disulphide, and ammonia; the mixture blackens, a yellow oil distils over, and a white mass remains which strongly resembles Liebig's hydromellone.

A beautifully crystallised nitrate of the new urea was prepared by treating the strong aqueous solution with nitric acid of sp. gr. 1·25. Its formula was found to be $(CS)''H_2N_2,HNO_3$. No hydrochlorate nor oxalate could be obtained.

Gold Compound.—On treating a saturated aqueous solution of the urea with neutral terchloride of gold, a reddish precipitate appeared at first, which quickly redissolved, when a yellow colour appeared in the liquid; it was slowly evaporated and yielded pearly monoclinic crystals, to which the author assigns the singular formula—

$$\left.\begin{matrix}(CS)''H_4N_2\\(CS)''H_4N_2\\Cl\end{matrix}\right\}Au$$

When the gold solution was employed in excess a very unstable compound was produced, which appeared to differ from the former one in containing only 1 equivalent of the urea and 2 of chlorine.

Platinum Compounds.—By methods analogous to the preceding, several platinum compounds were procured. For the most characteristic of them the author obtained the following formula:—

$$\left.\begin{matrix}(CS)''H_4N_2\\(CS)''H_4N_2\\Cl\\Cl\end{matrix}\right\}Pt'''',HCl$$

Silver Compound.—The action of nitrate of silver on the urea yielded silky crystals having the formula—

$$2[(CS)''H_4N_2]Ag_2O + 4H_2O.$$

* *Proc. Roy. Soc.*, lxi, 274.

This compound is decomposed by heat with slight explosion, sulphide of silver and a crystalline sublimate being formed.

When sulphur urea and hydrate of silver are heated with a little water for half-an-hour, sulphide of silver is formed, and the urea is converted into ordinary urea—

$$(CS)''H_4N_2 + Ag_2O = (CO)''H_4N_2 + Ag_2S.$$

It is, therefore, probable that in the little-known process for the preparation of carbamide by the action of oxide of silver on sulphocyanate of ammonium, there are really two stages—one in which sulphur-urea is formed, and one in which it is converted into ordinary urea and sulphide of silver.

Mercurial Compounds.—A crystalline compound was obtained to which the author assigns the formula—

$$2[(CS)''H_4N_2],3Hg''O,3H_2O.$$

But it appears probable that the compound—

$$(CS)''H_4N_2,4Hg''O,$$

and

$$\left.\begin{matrix} N_2O_5 \\ (CS)''H_4N_2 \\ (CS)''H_4N_2 \end{matrix}\right\} 3Hg''O,$$

are likewise produced in some reactions.

All ureas previously obtained possess more or less strongly marked basic properties, and the author believes that the new compound is the first instance known of a urea which manifests strongly marked acid and feeble basic properties. It follows from this investigation that the new compound is the true sulpho-carbamide, the primary of the series of compound sulpho-ureas discovered by Hofmann, and that sulpho-cyanate of ammonium must be regarded as the strict analogue of cyanate of ammonium. The author gives a list of Hofmann's compounds, and points out how simply they all relate themselves to sulphur urea. The following will serve by way of illustration:—

Sulpho-carbamide $\left.\begin{matrix} (CS)'' \\ H_2 \\ H_2 \end{matrix}\right\} N_2$

Phenyl-sulphocarbamide $\left.\begin{matrix} (CS)'' \\ C_6H_5 \\ H_3 \end{matrix}\right\} N_2$

The author concludes by predicting the formation of sulphur-urea by the action of heat on sulphocarbamate of ammonium. Such a reaction would be perfectly parallel with that by which Bassaroff produced urea, namely, by the dehydration of carbamate of ammonium.

The President remarked upon the great beauty and simplicity of the primary reaction effected by the author.

Professor Odling had no observations to make in direct discussion of the subject of the paper, but its close connection with urea tempted him to make a few remarks on the interesting theoretical question of the constitution of that compound. The current belief at present was that urea was identical with carbamide, and some facts were strongly in favour of this view; but, as he had pointed out some time ago, other facts were discordant, and Messrs. Wanklyn and Gamgee had lately, from experiments of their own, proposed a perfectly different formula for urea. There was a fundamental difference in the two views, and, in fact, we could not as yet say that we know the mode in which the carbon of urea was connected with the nitrogen. In addition to these two views a third had been suggested by Professor Kolbe, which, like everything that fell from his lips, was entitled to the most respectful consideration of chemists. Kolbe maintained that urea was not carbamide, but an amide of carbamic acid, and he wrote its formula thus:—

$$\left.\begin{matrix} (CO)''H_2N \\ H_2 \end{matrix}\right\} N$$

It appeared, however, to the speaker, that this was but a variation in the mode of writing the formula. He found himself unable to perceive how the amide of carbamic acid could be a different substance from carbamide. Possibly some disciple of Professor Kolbe—and most likely some were present—could point out where the difference lay.

Professor Wanklyn had nothing to add to the arguments which he, in conjunction with Mr. Gamgee, laid before the Chemical Society on a former occasion. He believed that urea was not carbamide, because he found it wanting in some of the common reactions of the amides.

As there was no further business before the Society, Sir Benjamin Brodie, whose re-appearance after a somewhat lengthened absence was cordially hailed by the President and Fellows, drew the attention of the meeting to a very remarkable paper by Berthelot, published in the last number of the *Comptes Rendus*. Berthelot had subjected a mixture of acetylene and nitrogen to the action of the electric discharge, and had thus, by a direct union of radicals, formed hydrocyanic acid—

$$C_2H_2 + N_2 = 2HCN.$$

Nearly the whole of the acetylene employed combined with nitrogen, and the reaction might be said to be strictly analogous to that in which hydrochloric acid was produced by double decomposition—

$$H_2 + Cl_2 = 2HCl.$$

The meeting then adjourned until January 21, 1869.

FOREIGN SCIENCE.

Paris, Dec. 30, 1868.

Kreatinine, an index of putrefaction.—The bleaching of wood pulp. Academy of Sciences: Behaviour of chlorides of sodium and potassium in presence of metallic vapours.—Estimation of nitrites in presence of nitrates and organic matter.—Cinnamate of benzile.

An index of the commencement of putrefaction in many animal substances may possibly be found by the presence of kreatinine. In a note on the presence of this body in putrified whey, M. Commaille, among other interesting things, mentions the above fact. Some filtered whey was placed in a flask, simply covered with paper, and set aside for about a year. The whey fermented and then putrified; numerous microzymas made their appearance, and the liquid became coloured a deep brown. Afterwards, the animal life gave place to a thick mass of spores; the fœtid odour was succeeded by a musty odour only. The liquid thus altered was filtered, evaporated on the water-bath, and treated with alcohol of 85°, which became strongly coloured. This alcoholic solution was evaporated and the residue treated with alcohol of 90°, which removed a portion; the substances obtained from the evaporation of the alcohol of 90° were divided by alcohol of 95°. That portion undissolved treated with water gave abundant crystals containing much mineral matter. Calcined, these crystals leave a white and saline ash; treated, after solution, with nitrate of silver they yield a voluminous precipate, which cedes to boiling water a small quantity of long needles, which are perhaps nitrate of kreatinine. The portion removed by alcohol of 95° furnishes, upon evaporation of the liquid, numerous crystals, which, under the microscope, appear as rectangular plates. These crystals are soluble in water and alcohol, insoluble in ether; they react as follows:—with nitrate of silver, a white magma, soon resolved into silky needles of double nitrate of silver and kreatinine; with syrupy chloride of zinc, small masses, which, examined under the microscope, appear as fine needles in radiating groups; these crystals are double chloride of zinc and kreatinine; with recently precipitated binoxide of mercury, at ebullition, metallic mercury. The kreatinine thus obtained is far from pure. Kreatinine ($C_8H_7N_3O_2$) occurs in the putrified whey from the dehydration of the kreatine ($C_8H_9N_3O_4,2HO$) already present in the milk. Urine, which has been exposed to the air for some weeks, contains no longer kreatine, but only kreatinine. It would thus seem that the small quantity

of kreatinine found in beef tea and recent urine indicates an alteration, inappreciable, one may add, by other means. Kreatine is, in fact, much more often found in fresh animal substances than kreatinine. The reason that kreatine has not been found in milk is probably the great amount of other materials present with it; and only when the lactine has been destroyed by fermentation and putrefaction, it becomes easy to detect in the whey the derivative kreatinine. The detection of a substance hitherto considered excrementitious in milk is worthy of remark. A further analogy between milk, blood, and meat, is also established.

A process of bleaching wood pulp has been made known by M. Orioli. He has recognised (1) that chloride of lime however little in excess, has a tendency to produce a yellow tint; (2) that all the strong acids turn the paste red under the action of the sun, or in some time without sunlight, in the presence of moisture; (3) that the slightest trace of iron is sufficient to blacken the paste in a very short time. These objectionable results are obviated by the following mixture:—For 100 kilogrammes of wood pulp 800 grammes of oxalic are employed, this serving the double purpose of bleaching the colouring matter already oxidised and of neutralising the alkaline principles favourable to oxidation; 2 kilogs. of sulphate of alumina, perfectly free from iron, are added. The principal agent in this new bleaching process is the oxalic acid, the energetic action of which on vegetable colouring matters is well known. The sulphate of alumina added does not bleach of itself, but it forms with the colouring matter of the wood a nearly colourless lake, which enables the brilliancy of the product to be heightened.

On the 9th November, the following papers were brought before the Academy:—"On Isomeric Compounds of the Sulphocyanic Ethers, Homologues and Analogues of the Ethylic Essence of Mustard," by M. Hofmann; "On the Theory of Scintillation," by M. Jamin; "Effects of an Elevation of Temperature on the Calorific Phenomena Accompanying Electrolysis," by M. Raoult; "On the Pyrogenic Formation of Acetylene from the Benzilic Series," by M. Berthelot; "On the Atractylic Acid and the Atractylates, Proximate Constituents Extracted from the Root of the *Atractylis gummifera*," by M. Lefranc; "On a Method Suitable for the Formation of Emetics and Other Double Tartrates," by M. Henry; and M. Poulet addressed a note "On the Effects of the Carotid Injection of Alkaline Urates."

At the meeting on the 16th, the following memoirs were communicated. "On the Scintillation of a Reflected Light," by M. Chevreul; "Isomeric Compounds of Sulphocyanic Ethers," "Comparison of the Metamorphoses of the Essences of Mustard and of Sulphocyanic Ethers," by M. Hofmann; "Researches concerning the Mecanics of Atoms," by M. Lucas; "Experiments on the Electric Spark," by M. Seguin; "On the Theory of Electrodynamic Actions," by M. Reynard; "Determination of the Heat from the Combustion of Oil," by MM. Scheurer-Kestner and Meunier; "On the Production of Electric Discharges in the form of a Crescent by means of Holtz's Machine," by M. Gaiffe; and "On the Calorific Phenomena which accompany Electrolysis," by M. Rauolt.

On the 23rd November the following memoirs were submitted to Academy:—"Thermal Researches on the Galvanic Battery," by M. Favre; "On the Behaviour of the Chlorides of Potassium and Sodium in the presence of certain Metallic Vapours, particularly Sodium Vapours," by M. Le Roux; "Researches on Nitrous Acid," by M. Chabrier; "Chemical Examinations of Five Samples of Gas from the Petroleum Springs of North America," by M. Fouqué; "On Cinnamate of Benzile," by M. Grimaux; "A Reclamation of Priority concerning the Chloride of Silver Battery constructed by Drs. Warren De La Rue and Miller," by M. Pincus, completes the list.

On the 30th November, MM. Milne-Edwards, Brongniart, Becquerel, Elie de Beaumont, and Coste were formed into a commission to propose a question for the Bordin Prize in 1869. M. Becquerel presented a sixth memoir "On the Electro-Capillary Phenomena of Diffusion, the Formation of Oxides, Silicates, Crystallised Hydrated Aluminates, and the Effects of Diffusion between Liquids which do not Mix." The following other communications were also made at this meeting:—"On the Temperature of Flames and its relation to Pressure," by M. Deville; "Study of the Obscure Calorific Spectra," by M. Desains; "On some New Carbides of Hydrogen," by M. Fritzsche; "On a Phenomenon of Fracture produced in the middle of some Blocks of Tin by the Action of Intense Cold," by the same author; "On a Modification in the Humid Method of Estimating Silver," by M. Stas; "On the Applications of Aluminium Bronze," by M. de St. Cricq Casaux; and "On the Transformation Suffered by Molecular Granulations of various origin in Solutions of Cane Sugar," by M. Le Ricque de Monchy. M. Elie de Beaumont presented a specimen of devitrified glass, and pointed out the analogies presented by this specimen with certain rocks of igneous origin. M. Palmieri continues his study of Vesuvius, and describes the eruption on the 15th November; and M. Chacornac made known the results of his researches on the physical constitution of the sun.

M. Le Roux has made some experiments with the vapour of sodium, and examined its capability or incapability of passing through rock salt. Two crucibles of rock salt were prepared, a thin plate of the same substance placed between them, and in one of the cavities sodium was placed. Notwithstanding a bright red heat maintained for several hours, the piece which was not in direct contact with the sodium vapour remained completely unaltered, even where it had been in contact with the plate already completely penetrated. Chloride of sodium is not attacked by the vapour of sodium, but soda corrodes it energetically. A very small quantity of soda suffices to hermetically seal two surfaces of rock salt, sodium preserving its lustre for several months in a crucible of this kind. Potassium vapour does not attack its chloride, but it covers the chloride with a bright blue substance in which, possibly, chemists recognise the suboxide of potassium.

M. Chabrier has studied at nitrification works, in particular circumstances, the different degrees of oxidation of the nitrogen, and especially nitrous acid. He has devoted attention to the estimation of this acid in saline mixtures, where nitrites and nitrates occur together with reducing agents. He submits to the Academy the result of the first part of his researches. The facts contained in this memoir are deduced from the following conclusions: (1) in liquids containing at the same time nitrites, nitrates, and organic matter, the nitrous acid of the nitrites may be determined by the decolourising action which hyposulphite of soda exerts on the iodide of starch, produced by the reaction of the nitrites on iodide of potassium in presence of starch and dilute sulphuric acid; (2) in the absence of nitrates and organic matter the determination could be more easily made by the decolouration of indigo solution, operating with the aid of heat, but out of contact with the air.

M. Grimaux prepares cinnamate of benzile by placing in a flask connected with a Liebig's condenser disposed inversely, alcohol, chloride of benzile, and dried cinnamate of soda. The cinnamate of soda being very slightly soluble it requires to be introduced in small portions at a time. The alcohol having distilled over water is added and the pasty deposit washed with an alkaline solution to remove cinnamic acid; ether is afterwards poured on and the deposit after this washing is dried over chloride of calcium, the ether removed by heating on the water bath, and the oily residue distilled in a vacuum. The distillate collected near 225° and 235°, cinnamate of benzile, is in the form of an oily liquid, which afterwards becomes a transparent solid. Cinnamate of benzile ($C_{16}H_{14}O_2$) occurs in small brilliant prisms, melting at 39°, and decomposing at about 350°. M. Fremy's metacinnamine appears to be pure cinnamate of benzile and not styracine (cinnamate of styrone) as MM. Kopp and Kraut have thought.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

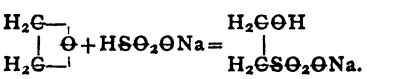
Action of Potassium Cyanate upon Amido-acids.—N. Menschutkin.—On mixing with a saturated boiling solution of sulphuric amidobenzoic acid, a saturated solution of potassium cyanate, oxybenzuraminic acid is formed, which, on cooling, separates in small crystals. The formation of this acid is shown by the following equation:—

$$[C_7H_5(NH_2)O_2]_2.H_2SO_4+2KCNO = 2CO(C_7H_4O.HO)H_3N_2+K_2SO_4.$$

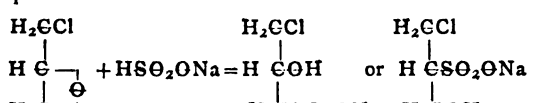
It is sparingly soluble in boiling water, better in alcohol, insoluble in ether; its salts are all soluble in water. Those which have been analysed (calcium, lead, silver) contained one atom of metal. The acid is readily nitrated by means of strong nitric acid. From amidoxybenzuraminic acid, and, perhaps, also from the amide of the oxy-acid, the author hopes, by the help of his reaction, to obtain oxybiureid.—*Zeitschr., Ch., N. F.*, iv., 275.

Notes by E. Erlenmeyer, L. Darmstädter, and Tscheppe:—

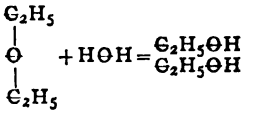
I. **Synthesis of Isethionic Acid.**—The sodium salt of this acid is readily formed if oxide of ethylene and sodium disulphite are heated together in a closed vessel to 100° C. The reaction is expressed by the following equation:—



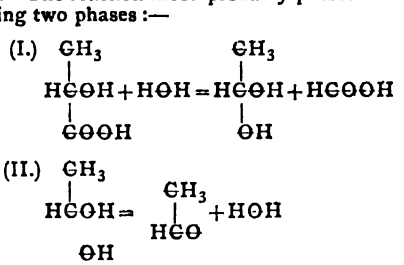
II. **Formation of Chlorhydroxypropylsulphonic Acid (Chlormethyl-isethionic Acid).**—Epichlorhydrin at 100° C. combines with sodium disulphite with formation of the sodium salt of the above acid, according to the equation—



III. **Formation of Alcohol from Ether.**—On heating ether with water to which has been added a small quantity of sulphuric acid for some time to between 150° and 180° C., the following reaction takes place:—



IV. **Decomposition of Fermentation Lactic Acid.**—This acid splits up into aldehyd and formic acid when heated for several hours with diluted sulphuric acid to 130° C. The reaction most probably passes through the following two phases:—



—*Ibid., N. F.*, iv., 341.

Dichlorphenol.—F. Fischer.—Dichlorphenol is obtained by passing a current of dry chlorine through phenol, and purified by repeated rectifications and recrystallisations from benzol. Thus prepared it is a solid body, crystallising in long white needles, which fuse at 42° to 43° C.; its boiling point is 209°, *i.e.*, nine degrees lower than that of monochlorphenol, which boils at 218°. Dichlorphenol forms crystalline salts of no great stability. Its ethyl ether, $C_6H_3Cl_2O.C_2H_5$, is obtained as a colourless oil boiling at 226° to 227°. It is readily converted into the nitro-compound $C_6H_2Cl_2(NO_2)OH$, which shows all the properties of that from the liquid dichlorphenol, as described by Laurent. Amidodichlorphenol may be obtained by the action of tin and chlorhydric acid upon the nitro-compound. It is described as a white crystalline body which, when moist, readily decomposes.—*Gött. Nachr.*, 1868, 171.

Behaviour of Metals in the Electric Current.—F. Wöhler. In addition to his experiments on silver (Chemical News, No. 463, p. 189), the author describes the following:—Palladium as positive electrode of two Bunsen's cells, immersed in acidulated (sulph. acid) water, becomes gradually covered with an almost black film of peroxide (PdO_2). Upon lead and thallium brown peroxide and black oxide are deposited. Osmium, in the ordinary porous condition, is freely converted into osmic acid (OsO_4). If, as electrolyte, a dilute solution of sodium hydrate is employed, the solution assumes a deep yellow colour, while, on the negative electrode metal is deposited. The same is the case with ruthenium. Osm-iridium in its natural state readily dissolves in the alkaline electrolyte.—(*Gött. Nachr.*, 1868, 169.)

Action of Iodhydric Acid upon Leucin and Tyrosin.—On heating in a sealed vessel pure leucin with fuming iodhydric acid to 140—150° C., for about 12 hours, the former takes up one atom of water and splits up into ammonia and capronic acid. Tyrosin, which is believed to contain ethylamine, was expected, under similar treatment, to yield that base, but instead of it ammonia was liberated. The author concludes from this experiment that tyrosine is not ethylamidoparoxybenzoic acid (Barth) but amidophloretinic acid, which, by the action of iodhydric acid, would break up into ammonia, phlorol, and carbonic dioxide; and, further, that the base which Schmidt and Nasse obtained by gently heating tyrosin is not ethyloxyphenylamine but amidophlorol.—(*Zeitschr., Ch., N. F.*, iv., 391.)

Synthesis of Guaiacol.—V. Gorup-Besanez. If a mixture of equal molecules of pyrocatechin, potassium hydrate, and potassium methylsulphate is heated in a sealed vessel to 160—170° C., a light brown, half-liquid mass is obtained which has all the properties of guaiacol. It is purified by repeated washings with water. Its formation takes place according to the following equation—

$$C_6H_6O_2+KHO+CH_3KSO_4=C_7H_8O_2+K_2SO_4+H_2O.$$

(*Ibid., N. F.*, iv., 392).

Sulphobenzylic Acid.—O. Böhler. Benzyl chloride, $C_6H_5.CH_2Cl$, obtained by the action of chlorine upon toluol, is converted into the potassium salt of a new sulpho acid on being boiled with a solution of neutral potassium sulphite. The composition of potassium sulphobenzylate is $C_6H_5.CH_2.SO_3K$. The acid may be set free by decomposing its lead salt with hydric sulphide. It is very soluble in water and in alcohol. Fuming nitric acid replaces one H by NO_2.—(*Ibid., N. F.*, iv., 440).

Ethyl Iodate.—K. Lisensko. A mixture of equal volumes of ethyl iodide and dry ether readily acts upon argentic iodate. If the temperature is not allowed to rise above + 10° C. the liquid remains colourless and the new ether undecomposed. The solution distils between 37° and 40°. The distillate at first floats upon the water with which it had been mixed, but on passing a current of air through the liquid, in order to drive off ethyl ether, it sinks to the bottom of the vessel. All attempts at further purification failed; the liquid boils at 75° under decomposition.—(*Ibid., N.F.*, iv., 455).

CORRESPONDENCE.

MR. BEANES'S PROCESS FOR TREATING ANIMAL CHARCOAL.

To the Editor of the Chemical News.

SIR,— In my paper on "Sugar Manufacture," reported in the CHEMICAL NEWS of the 18th inst., I have made a remark regarding Mr. Beane's process for treating animal charcoal with dry hydrochloric acid gas, which I find I am not in a position to substantiate, and which I therefore cancel. I beg also to express my regret for having published unadvisedly, and on insufficient evidence, a statement that might prove injurious to the interests of Mr. Beanes, and which that gentleman assures me is incorrect. I have elsewhere shown the superiority of the dry gas method over those formerly in use for removing calcic carbonate, &c., from charcoal; and while my opinion as regards the use of any of these processes in connection with sugar refining in this country remains unaltered, I am well aware that they are used with great advantage in continental factories where different circumstances obtain.—I am, &c.,

WM. WALLACE.

Glasgow, Dec. 28, 1868.

CHEMISTRY IN THE EXAMINATIONS OF THE DEPARTMENT OF SCIENCE AND ART.

To the Editor of the Chemical News.

SIR,—I am glad to find that my letter on the above subject has excited some little attention amongst your readers. One of your correspondents, "Woolwich," takes an objection to my statement, that of every ten chemical teachers not more than one has ever heard of "hydroxyl," and that of the remaining nine only one is likely to obtain any information respecting it from the ordinary manuals. Of course any estimate of this sort must necessarily be a matter of individual opinion, and I still retain mine, that taking the whole mass of teachers in this country, not one in ten ever heard of hydroxyl until they saw it in the recent syllabus of the Department; nor do I think that there is any discredit attaching to them for being unacquainted with it. The special theory of a particular teacher, almost entirely unnoticed by the ordinary works to which they are accustomed to refer to for information, and from which they have in past times derived their own knowledge, it is scarcely to be expected that they should know anything at all about. Your correspondent alleges that Dr. Frankland's views have been for some time before the world, and that they are shared in by other chemists of note. The first of these facts is unquestionably true, and the second probably is also, but that does not at all disprove my position that the theory of hydroxyl is altogether too new, too questionable, and too impractical to justify its being compulsorily taught to beginners, who have more than enough to do to learn the essential and most elementary facts of the science. I most fully admit that Dr. Frankland's hypothesis on this and other subjects are very ingenious, and have much to recommend them, but I am equally certain that if teachers are to be expected to communicate them to the average students who go up for the examination of the Department of Science and Art, their chances of success are infinitesimally small. I must fully coincide with your correspondent V. T. in his remarks as to the absurdity of expecting boys—and it must be remembered that most of the students in the classes for which the examinations of the Department of Science of Art are provided are really little better than boys in knowledge, even though they may be in years—to answer questions which involve a knowledge of a terminology which, though admirable enough in its way, is not yet by any means even generally, to say nothing of universally, adopted. The fact is, that many examiners, though competent enough for their posts, as far as their personal capabilities as scientific men is concerned, are quite unfitted to conduct examinations of the kind of candidates with whom they have to deal. They have been accustomed to teach young men of some education, and often of much intelligence, who are able to give up a good deal of time to the study of special subjects, and they forget that the great majority of the students in the science classes, which are now being established with such difficulty in various parts of the country, have neither the time nor the capability to master more than the merest rudiments of science; and this applies also to a great extent to the science classes in middle class school. I shall look with some interest to the results of the next examination of the Department; for if, as things at present seem to foreshadow, they should show that the standard of the examinations has been considerably raised, I believe that a blow will be struck at science teaching in this country from which it will take years to recover.—I am, &c.,

A TEACHER.

MISCELLANEOUS.

The Royal Polytechnic.—The Christmas entertainments of this institution include a lecture, on "Singing and Sensitive Flames" by Professor Pepper, and "The Mysterious Hand," which proves the spirit wonder called the "Planchette" to be a piece of jugglery. The hand is placed on a sheet of transparent plate-glass, and it distinctly writes answers to any questions proposed, the answers being communicated to the querist on a card, thus furnishing him with a specimen of the mysterious handwriting. There is also a musical entertainment by Mr. George Buckland, called "An Eastern Story"; an instructive lecture by Mr. J. L. King, on the "Phenomena of Nature;" and a magical illustration of the Old German Story, "The Spectre Barber," by Mr. and Mrs. Coote. Professor Pepper continues his admirable lecture on "A Machine-made Watch," and other amusing entertainments are provided for Christmas visitors.

Detecting the Adulteration of Olive and Sweet Almond Oils.—Lipowitz has recommended the use of hypochlorite of lime, bleaching powder, as a means of detecting the adulteration of olive and also of sweet almond oil with the oil, of poppy seed (Mohnöl). When eight parts of either olive oil or oil of sweet almonds is rubbed up and shaken with one part of bleaching powder and left at rest, it will be seen that even after some four or five hours a layer of clean and limpid oil separates and floats at the top and surface of the mixture, which layer is, if the oils operated upon are pure, at least half the bulk of the original mixture; if, however, poppy-seed oil is mixed with either of the two oils just mentioned, and the same experiment then repeated, the mixture gets the appearance of a liniment from which no oil separates. Sweet oil of almonds, adulterated with one-eighth part of poppy-seed oil, behaves as if it were almost pure poppy-seed oil. Büchner and Brande have found Lipowitz's statements correct as regards sweet oil of almonds but not as regards oil of olives; but they add that the olive oil they operated upon was already old. The action of Lipowitz's reagent is explained by the fact of the rapid oxidation of all so-called drying oils which, on drying, yield solid products before entirely changing, by continuously absorbing oxygen into water and carbonic acid. Linseed oil, hemp-seed oil, poppy-seed oil, oil from walnuts, croton oil, castor oil, are all drying oils. The

drying of drying oils is, in fact, a process of slow oxidation of these oils.—*N. Br. Arch.*

Silvering Glass Specula.—Several correspondents having made enquiries respecting Mr. Browning's silvering process we are induced to reprint the following:—

To Silver Glass Specula.—Prepare three standard solutions. Solution A—Crystals of nitrate of silver, 90 grains; distilled water, 4 ounces; dissolve. Solution B—Potassa, pure by alcohol, 1 ounce; distilled water, 25 ounces; dissolve. Solution C—Milk-sugar (in powder) ½ ounce; distilled water, 5 ounces. Solutions A and B will keep in stoppered bottles for any length of time; solution C must be fresh.

The Silvering Fluid.—To prepare sufficient for silvering an 8-inch speculum:—Pour 2 ounces of solution A into a glass vessel capable of holding 35 ounces. Add, drop by drop, stirring all the time (with a glass rod), as much liquid ammonia as is just necessary to obtain a clear solution of the grey precipitate first thrown down. Add 4 ounces of solution B. The brown-black precipitate formed must be just re-dissolved by the addition of more ammonia, as before. Add distilled water, until the bulk reaches 15 ounces, and add, drop by drop, some of solution A, until a grey precipitate, which does not re-dissolve after stirring for three minutes, is obtained; then add 15 ounces more of distilled water. Set this solution aside to settle. Do not filter. When all is ready for immersing the mirror, add to the silvering solution 2 ounces of solution C and stir gently and thoroughly. Solution C may be filtered.

To Prepare the Speculum.—Procure a circular block of wood 2 inches thick, and 2 inches less in diameter than the speculum. Into this should be screwed three eye-pins, at equal distances. To these pins fasten stout whipcord, making a secure loop at the top. Melt some pitch in any convenient vessel, and having placed the wooden block face upwards on a level table, pour on it the fluid pitch, and on the pitch place the back of the speculum, having previously moistened it with a thin film of spirit of turpentine to secure adhesion. Let the whole rest until the pitch is cold.

To Clean the Speculum.—Place the speculum, cemented to the circular block, face upwards, on a level table; pour on it a small quantity of strong nitric acid, and rub it gently all over the surface with a brush made by plugging a glass tube with pure cotton wool. Having perfectly cleaned the surface and sides, wash well with common water, aad finally with distilled water. Place the speculum face downwards in a dish containing a little rectified spirit of wine until the silvering fluid is ready.

To Immerse the Speculum—Take a circular dish about 3 inches deep, and 2 inches larger in diameter than the speculum. Mix in it the silvering solution and the solution C, and suspend the speculum face downwards in the liquid, which may rise about ¼ of an inch up the side of the speculum. (The silvering will be completed in from 50 to 70 minutes, according to temperature; 50 minutes will be found sufficient in summer.) When the silvering is completed, remove the speculum from the solution, and immediately wash with plenty of water, using at least two gallons, and finally with a little distilled water. Place the speculum on its edge on blotting paper to drain and dry. When perfectly dry, polish the film by gently rubbing, first with a piece of the softest wash-leather, using circular strokes, and finally with the addition of a little finest rouge. A "flat" may be silvered by fastening with pitch to a slice of cork, cleaning as above described, and using as much silvering fluid as will form a stratum about ½ inch deep beneath the mirror.

NOTES AND QUERIES.

Frosting Glass.—I should esteem it a great favour if you would give the method of frosting flint glass by the liquid as it is done on the Continent and in Stourbridge. I can do it with the fluoride of ammonium and hydrofluoric acid mixed together; the fluoride does not mix with the acid, so I have to put it on with a brush, and it is very uneven and patchy. Perhaps some of those learned chemists who are connected with your valuable paper might be able to instruct me so that I could do it practically. There is a way to do it with the fumes, but it is a very old way and a very bad way, and so very unhealthy.—R. B.

The Lines in the Spectrum.—Several years ago, when Bunsen and Kirchhoff were in Paris, Plucker and Rhumkorff proposed to them a difficulty in "Spectrum Analysis," which they did not answer. I have long been waiting to see an answer. The difficulty is one which meets a person at his first trial of a spectroscope. It is this:—The vapour spectra are bands, not lines, like Fraunhofer's, and these bands vary in width with the opening of the slit. Take, *e.g.*, sodium. A candle held in front of the slit gives a variable band, not a line or pair of lines. It is not possible but that this difficulty has been most fully explained; but I have not been able to obtain explanation or conquer the difficulty with a plain spectroscope. The sun lines are quite easily had, even with a common prism in the hand; not so vapour lines.—E. K.

MEETINGS FOR THE WEEK.

Monday, 4th.—Medical, 8.
—— London Institution, 6.
Tuesday, 5th.—Royal Institution, 3. Professor Odling, F.R.S., "On the Chemical Changes of Carbon."
Wednesday, 6th—Microscopical, 8.
—— Pharmaceutical, 8.
Thursday, 7th.—Royal, 8½
—— Royal Society Club, 6.
—— Royal Institution, 3. Professor Odling, F.R.S., "On the Chemical Changes of Carbon."
Friday, 8th.—Astronomical, 8.
Saturday, 9th.—Royal Institution, 3. Professor Odling, F.R.S., "On the Chemical Changes of Carbon."

TO CORRESPONDENTS.

J. N. F.—There is danger of the subject of Science Teaching becoming wearisome to our readers.

E. K.—1. The new edition of Fownes's "Manual" will prove very useful in addition to Miller's "Chemistry." 2. See Notes and Queries.

Josephus.—Add hydrochloric or sulphuric acid to a strong solution of the salts. Benzoic acid will be precipitated, as it is much less soluble in water than succinic acid. The dry acids may also be separated by taking advantage of their different volatility.

J. Walton wishes to know of a book on colour making, applicable to the artists' colour business.

J. Wood.—1. We are not aware of any special work on the subject. 2. The best book on analysis is Fresenius's.

A Constant Subscriber.—Solid carbonate of ammonia will answer all your requirements.

J. Hardman.—Messrs. Truman, Hanbury, Buxton, and Co., have one of the ice machines you mention. One of 18-horse power would cost £2,000.

Communications have been received from Dr. Angus Smith, F.R.S.; S. Wilson; Dr. Odling, F.R.S.; Grimwade, Ridley, and Co.; J. R. Sawyer; J. L. Sinclair, Auckland, N.Z.; W. T. Suffolk; T. Dicker; Messrs. Townsend and Adams; F. B. Baker; R. Broadhurst; J. Wood; J. F. Sprague; Marshall Hall; Dr. H. Bence Jones, F.R.S.; H. Bassett; J. Watson; R. R. Tatlock; E. Kernan; the Prior of the Monastery of St. Joseph (with enclosure); J. Pryde; J. Mackie; Corbett and Wood; B. Nickels; U. J. Kay-Shuttleworth; and W. J. Bush and Co. (with enclosure).

BOOKS RECEIVED.

Histoire des Doctrines Chimique, Depuis Lavoisier jusqu'a Nos Jours. Par Ad. Wurtz. Paris: L. Hachette and Co.
Tweedie's Temperance Year Book of Facts and History. London: W. Tweedie.
The Journal of Materia Medica. New Lebanon, N.Y.: Tilden and Co.

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THE CHEMICAL NEWS.

VOL. XIX. No. 475.

ON THE

CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,

(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, ESQ., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE I.

MARBLE—LIME—CARBONIC GAS.

MARBLE, a brittle solid, capable of being crushed and ground into powder—Its want of action on, and insolubility in, water—Occurrence of effervescence on treatment of marble with vinegar or acetic acid; also with other acids, as muriatic acid, for instance—Effervescence due to liberation of a particular kind of air or gas—Same kind of air or gas evolved from marble by action of a red heat—Marble resolved by ignition into above kind of air or gas, and a residue of quicklime—Resulting quicklime distinguished from original marble in various ways—Non-occurrence of effervescence on its being treated with acids—Evolution of heat on its being slaked by water—Its solubility in water—Lime-water characterised by its alkaline reaction upon vegetable colouring matters, and its precipitation of different metallic salts—Combination with lime of the air evolved from marble, to re-produce marble—Chemical identity of marble with chalk, limestone, calc-spar, coral, pearl, &c.—Solubility of all these substances in muriatic acid with effervescence, and their conversion into quicklime by ignition—Extinction of flame of ordinary combustibles by air evolved from marble—Combustion of different metals, as iron, zinc, magnesium, and sodium, in ordinary air—Combustion of sodium in air from marble, with separation of carbon or charcoal—Air from marble formerly called fixed air, on account of its being fixed or absorbed by lime, so as to produce chalk—Now called carbonic gas, from its containing carbon or charcoal—Production of carbonic gas by burning charcoal in ordinary air—Conversion of soluble lime into insoluble chalk or marble, a test for carbonic gas.

THOSE of you who are sitting in the front benches, and the no less youthful Fellows whom I see scattered about the theatre, who form my especial audience to-day, have, I suppose, most of you, very recently been acquiring at school much valuable knowledge with regard to words, and numbers, and events; and now in your holiday time, like many generations of schoolboys before you, you come to the Royal Institution to learn a little about *things*—about material objects that can be touched and handled and weighed; and in a little time I think most of you will be surprised to find how very interesting and how curious the properties of even the most common-place things are when intelligently examined, and in particular how very remarkable are the changes which this common and, at first sight, uninteresting looking substance—charcoal—is capable of undergoing and effecting.

Now although it is my intention to talk to you about charcoal or carbon, I do not intend to begin with carbon, but with a very different looking substance—one which you may be inclined to think can have but little connection with charcoal at all, and yet which in reality, as I hope to show you, has a very intimate connection with it indeed,—I mean the substance I hold in my hand, and which you will at once recognise as a piece of marble—a slab of marble.

Now, as we have only some half-dozen hours to talk of the many wonderful changes of this wonderful charcoal, we will put aside all preliminaries, and begin at once with an experimental enquiry into the properties of this white substance, marble, and its relation to that black substance, charcoal. We will submit it to several tests or trials, and we will see how it behaves under those trials; and, first of all, we will try the effect of a blow upon it. If we take the marble, and hit it a rather sharp blow with a hammer, you will observe that the marble very quickly breaks to pieces. Here we have a number of similar pieces of marble that have been broken off in this manner; here we have a jar of broken marble, and here is the same marble in a smaller state of division. Now, if I take some ordinary pieces of marble, and put them into a druggists' mortar and bring the pestle down upon them, I have the power of reducing them to a powder of a greater or less degree of fineness. Here we have some marble which has been powdered in this manner; here is some in a rather coarser state; here, again, is some which has been very finely powdered for a special purpose; and by chemical means we can get the marble into a much finer state of division, which we speak of as precipitated marble. Well, then, the first thing we learn about marble is, that it is a very brittle substance. That is not a great deal to know, but it is something; and you will find in science that there is no fact, however small, that may not be found important. If I put a piece of lead under the hammer and strike it I cannot break it; or if I put a piece into a mortar I cannot powder it. Marble, then, is a substance entirely different from lead in these respects, inasmuch as the marble possesses

* Reported verbatim, by permission of the Author, for this Journal.

property of brittleness which is not possessed by lead.

So much, then, for the effect of a blow upon marble. Now let us try it in some other way; and first of all we will treat it with water. In these vessels are two large thermometers, which I hope will be visible over the greater part of the theatre; one of these vessels contains a substance which is somewhat of the nature of common salt; it is not ordinary common salt, but it is a substance called salt-cake—a kind of salt that cakes together a good deal; in the other vessel there is common marble. Now we are going to wet both these substances, and to notice what happens. We will take a little water, and first of all we will wet this salt substance a little with the water, and observe what takes place. And, now, having wetted the salt substance, we will wet the marble, and notice whether any difference is observable between the two cases. I think that you will find, in the course of a very few minutes, that the liquid of this thermometer which is placed in the salt-cake, and which originally stood rather lower than the other thermometer, will rise rapidly, showing that we get a large amount of heat evolved. Salt cake, then, is a substance which, when moistened with water, gives out a considerable amount of heat; whereas marble is a substance which, when wetted, does not give out heat. You see that already the liquid in the thermometer connected with the salt cake is gradually rising, and it will go on rising, I have no doubt, until eventually it reaches up to the very top of the stem. [At a subsequent stage of the lecture the professor pointed out that the thermometer had risen to a considerable height.] We find, then, that there is in this respect a difference between the marble and the other substance.

And now let us try the effects of water upon marble in some other ways. You know that there are many substances which, when they are put into water, disappear; in other words, they dissolve in the water. Certain other substances do not disappear; you have a very good illustration of this in the case of sea salt and sea sand. You have observed, when you have been by the sea side, that the sea salt remains in the water, whereas the sand is deposited upon the shore. Now let us ascertain whether marble is a substance which, like sea salt, dissolves in water, or, like sea sand, remains undissolved. As I have compared the marble with the lead and with the salt cake, I will now compare it with certain substances which are soluble in water. Here I will take a substance which possesses a colour; it is some of the substance called aniline blue,—one of the colours made from coal tar. We will throw some of this blue colour into water, and now notice what happens. You see the beautiful streaks of colour which are gradually descending. You see in this case, in fact, that we are dealing with a soluble substance—a substance which dissolves very rapidly in water, and by its solution gives rise to these beautiful streaks of colour. Here, then, we have an illustration of a substance which is soluble in water, and, at the same time, is possessed of a very brilliant colour. We will now pass on to the consideration of another substance. It is one which is not very soluble in water, but is very readily soluble in dilute spirit of wine. We take some of this substance, and put it into the funnel, and pour upon it some spirit of wine, and you see that in this case, also, the substance dissolves very readily in the liquid. You see at the present time a streak of red colouring matter gradually descending through the liquid. Here, then, you have another illustration of a substance which dissolves in water with tolerable facility.

Now, it is quite obvious, we must not compare marble with one of these beautiful coloured substances, but we will compare it with some colourless substance, and for this purpose I will take some common salt. Into this funnel I will pour a quantity of common salt, so as in a great measure to fill the funnel: you see the funnel is now filled with salt. In the other funnel we will place, in the same way, some marble, and we will notice whether any difference is observable in the case of the funnel filled with marble and the funnel filled with salt. In this experiment we shall not see streaks of beautiful colour, but I think those who are near will be able to observe that, in the case of the common salt, there is a stream of liquid—which is, in fact, a solution of salt—descending through the water beneath; whereas nothing of the kind will be observable in the case of the marble. Whether this is observable or not, there is one effect which I think will be noticed by all, and that will be that in the course of ten minutes or so the whole of the salt which we have put into this funnel will disappear, whereas the marble will remain.

We come, then, to this conclusion—that marble is a substance which, so far as we have gone, does not dissolve perceptibly in water. Here we have some marble in a bottle of water, and it is quite clear that the whole of the marble does not dissolve; but the question chemically is, has *any* of the marble dissolved? Has the water got any marble dissolved in it? I will show you the method which the chemist adopts for the purpose of determining this. He takes a funnel with some filtering paper in it, and he pours the liquid through the funnel; the object of this filtration being to remove any particles of marble which may be undissolved in the water.

The question then that we have to consider is whether the filtered water has got any marble in it, and to find out that point we take some of the water and boil it away. You know that when water is boiled it gradually gets less and less in quantity, and eventually it boils entirely away. Now if this water is *nothing but water*, it will boil away and leave no residue; but if it is water containing marble, the water will boil away, and the marble will not boil away but will be left behind; and thus when we want to know whether the water has taken any marble into solution we filter the liquid, in this way, and then boil it away, and observe whether there is a residue or not. So much, then, for the action of water upon marble.

The next substance of which we will try the action upon marble is a very common substance, namely, vinegar. For this purpose we will take some finely powdered marble and moisten it thoroughly with water, and then we will act upon it with vinegar. We pour some vinegar upon the marble, and notice whether or not any effect takes place. We shall see in the course of a minute or two that a considerable action is taking place; you will observe that the vinegar will become covered with froth. Now in this case the marble, which would not dissolve in water, is dissolving in the vinegar, and not only is it dissolving, but it is behaving very differently from the manner in which the common salt dissolved in this water [pointing to the solution of salt], and in which the magenta dissolved in this other vessel. You observe that the marble dissolves in the vinegar with a considerable amount of froth. Now what is the nature of that substance? Vinegar, you know, is a sour substance; to what does it owe this sourness? We find that it contains a sour substance called an acid. Chemists are acquainted with a large number of sour substances called acids, to which they have given different names. This acid contained in vinegar is called the *acid* acid, or *acetic* acid; but the amount of acetic acid existing in vinegar is extremely small. Therefore, if, instead of taking vinegar, we take some of the substance which gives its sourness to vinegar—the acetic acid itself—we shall find, in that case, that the action is much more decided. I will now employ acetic acid instead of vinegar, and you observe in this case that the marble dissolves with considerable rapidity, and we get in this case a much better marked effervescence than we had by means of the vinegar.

Now, as I have said, chemists are acquainted with a great number of different acids. There is this acetic acid, or the acid acid; then there is the acid which exists in sour grapes, and which is called tartaric acid; then there is an acid existing in sour lemons, called citric acid; there is an acid existing in apples, called malic acid, and an acid existing in sorrel, called oxalic acid; then there is an acid got from sulphur, called sulphuric acid; another got from nitre, called nitric acid; and, lastly, there is an acid got from sea salt which is called muriatic acid. Now muriatic acid is the acid which we will try next.

You will find that muriatic acid is an acid which is much stronger than acetic acid, and that when we come to act upon marble with muriatic acid, we shall get a very much more rapid effervescence. In this case, indeed, the effervescence is so rapid, that I shall not need to employ the marble in the fine state of division in which it was when submitted to the action of the other acid. I will take some of this marble in the form of lumps, upon which the vinegar would be almost without action, and upon which the acetic acid would have a very small effect; but with the muriatic acid I can act upon the marble even in the form of these coarse broken pieces, and you see that in this case we get a very violent effervescence.

We have now ascertained these properties as belonging to marble—that when it is subjected to a blow from a hammer it breaks readily; that when exposed to the action of water it does not dissolve; and that when acted upon by vinegar, or acetic acid, or muriatic acid, it not only dissolves, but also gives rise to this phenomena of frothing or effervescence.

Let us now examine into the nature of this effervescence; and for this purpose we will try to perform the experiment in a somewhat different manner. I have here a jar containing some marble, and this marble is covered with water; at the top of the water is an inverted funnel, the object of which you will see presently. In this case, instead of using acetic acid, we will add some of the acid from sea salt, which we call muriatic acid; and you see that in this case we quickly get an abundant effervescence. We cover this with the funnel and fill up the vessel with water, and in a minute or two you will see what is the nature of this effervescence. You see that it consists in the formation of a large number of bubbles of air underneath the water; and here you see these bubbles of air rushing up through the neck of the funnel into the water above.

Now I wonder whether we can collect any of these bubbles of gas, and find out what sort of air they consist of; we will try. Let us take this glass cylinder and fill it with water, and invert it over the bubbles. If I were to invert the cylinder just as it is after being filled with water, you would find that the air would rush into the cylinder, and the water would simultaneously run out; but if I take the precaution to cover the mouth of the glass with a card, and

then invert it so as to keep out the air, under those circumstances the water will remain in the cylinder perfectly well. The air cannot get in, and consequently the water cannot get out. If I put this card on the end of the glass cylinder, I prevent the air from gaining access, and consequently the water does not escape; when the air cannot get in, the water cannot get out.

I have here another arrangement of the same kind, and by it we will now endeavour to collect some of the gas which is coming up from the marble. I take here a tube, filled with water, and instead of closing it with a card I simply close it with my thumb, and support the end of it under the water over the bubbles of gas; and in this manner, no doubt, we shall be able to collect under the water some of these bubbles of air or gas which are rising from the marble, and which have been generated by the action of the muriatic acid upon the marble. We will now try to get some more of this gas of marble, by acting upon the marble by acid in a bottle instead of in a cylinder. Here is some in a bottle, and in this way we get a considerable effervescence; we put into the neck of the bottle a cork, with a piece of bent tube attached to a piece of vulcanised tube. You see that here we get a jar full of gas in a minute or two, for we are now performing the experiment on a somewhat large scale, while in the other case we performed it on a small scale. This effervescence consists in the formation of bubbles of air beneath the surface of the water, and these bubbles of air we are capable of collecting. In a minute or two we shall have this jar full of the air which is given off from the marble, and then, having obtained it, we shall be able to ascertain its nature. The vessel is now full of the air from marble, and so we will close it with a glass plate and put it aside for a minute or two, until we require it.

We have, then, tried the effect of water and of acids upon our marble; now let us try the effect of heat upon it. For this purpose we will take some of our finely powdered marble, and subject it to the action of a strong heat; and at the same time that I pour some of the marble into this capsule I will also pour some more of the same marble into a glass which shall stand by the side of the capsule, so that when the experiment is complete we may know that we have two specimens of the same substance—one of them being the substance before the action of heat upon it, and the other being the same substance after it has been acted upon by heat. We will take this platinum dish or capsule containing the marble, and act upon it by a strong heat. I will let it be uncovered at first, so that you may see how hot it becomes, and then, in order that the heat may be greater, we will cover it up with this platinum cover, which will cause it to become still hotter. [The dish containing the marble was then submitted to a blowpipe flame]. But I will also expose some marble to heat in another way; instead of putting it into a dish we will put it into this platinum tube, and having filled the tube with marble we will heat it very strongly, and notice what happens. Our tube is now full of marble; we will, therefore, insert in one end of it a cork having a glass tube passing through it, and we will now heat the platinum tube very strongly by means of a blowpipe flame; but before we submit it to the heat we will attach to the glass tube an apparatus for the purpose of ascertaining whether or not any kind of air or gas is given off under these circumstances. For this purpose we will take another glass cylinder and fill it with water and invert it in a dish of water over the end of the tube from which the bubbles of gas would issue, just as we did in the other case. We are now making our platinum tube very hot by means of the blowpipe, and you will notice in a minute or two whether or not any gas is being evolved. We dip the mouth of the tube underneath the cylinder of water, and you will see that one of the effects of heat upon the marble contained in the tube is to drive off a kind of air or gas.

The point, then, to which we have now arrived is that, whether you act upon marble by an acid, or act upon it by heat, in either case you get evolved a particular kind of air or gas, into the properties of which air or gas we will presently enquire.

The question, then, that arises is this. What is the nature of the gas or air which is given off in these cases? Is the same kind of air given off by the marble under the action of heat as is given off by it under the action of the acids, or is it a different kind of air? Well, the only way to answer this question, as to answer a great number of others, is to try it. We will try whether the kind of air that is given off by the action of heat is the same kind of air that is given off by the action of the acid, or a different kind of air; and for this purpose we will examine more particularly the nature of the air that is given off by the marble through the effect of the acid upon it. We will take a solution containing lead, which is very well known to medical men under the name of Goulard solution; it is a solution of basic sugar of lead. We will allow the gas given off by the marble to bubble up through our solution of basic sugar of lead, and see whether any action takes place; we see, in point of fact, that there is an effect, and that the solution is rapidly becoming milky. We will now take another portion of the gas given off from the marble under the action of the acid, and try in another way what its properties are; we will take a piece of lighted stick and immerse it in the gas, and it is, as you see, immediately ex-

tinguished. Thus we find, then, that the air which is given off from the marble by means of the acid has these two properties; it renders the sugar of lead solution white and turbid, and it extinguishes flame. We will now take a jar of the gas obtained from marble by the action of heat, and observe the effect of this gas upon the solution of sugar of lead. We cause some of the gas that has been produced from the marble by heat to bubble up through a solution of sugar of lead, and you see that in this, as in the other case, the gas evolved from the marble has the property of rendering the basic sugar of lead turbid, just as did the gas evolved from the marble by the action of the acid. In this respect, therefore, the gas evolved from marble by these two different agencies appears to be the same in both instances. Now we will ascertain whether the gas which is evolved from marble by the action of heat has also the property of extinguishing flame. For this purpose we will get our cylinder full of the gas which has been expelled by the heat from the marble, and you see that directly I put in a lighted taper it is extinguished by the gas contained in the cylinder. We have therefore tried the gas produced by these two different methods, and we find that it behaves in the same way in both cases, as far as we have experimented; and, in fact, I may tell you that, no matter how you subject to trial the gases evolved under these different kinds of action, you will find that they always behave the same, or, in other words, that the air given off from marble by the action of heat is identical with the kind of air given off from marble by the action of acids.

Now let us see what sort of a substance is the residue which remains behind; and for this purpose we will examine the substance which we have been subjecting in this way to the action of heat. You will remember that in this beaker we had some of the original marble which we did not expose to heat; and now we will take some of the marble which has been exposed to heat, and see whether or not any difference is observable in the behaviour of the two sorts. Inasmuch as it is possible, or, in fact, very probable, that the action of the heat may not have been pushed sufficiently far, we will not take the whole of the marble which has been exposed to heat, but only a portion of it, and the remainder we will continue to submit to the action of the heat a little longer. Before experimenting with this portion of the marble which has been strongly heated, we will wait a minute or two, that it may become a little cooler; at present it is so hot that I am not well able to bear my hand upon it. When it is cooler I will try the effect of water upon it, and we will see whether the marble which has been thus heated behaves in a different way from the marble which has not been heated. (It is now practically cold; if not absolutely cold, but I can bear my hand upon it.) You will now observe that directly I moisten with water this marble which has been heated, it gives out a great amount of heat and a great quantity of steam, and has now become so hot that it is impossible for anyone to bear his hand upon it; whereas this marble which has not been submitted to the action of heat, is quite unaffected by the water with which I moisten it.

We will now go on a little further, and notice whether that marble which has been so strongly heated will effervesce under the action of an acid, and if it does effervesce, whether it effervesces to the same extent as the other marble. In the case of the marble which has been heated, you see we get some effervescence, although not in the same degree; and I am in hopes that in a short time, when the remainder of the heated marble has been subjected to the heat a little longer, we shall get a product which will give us no effervescence.

Hitherto I have been talking about the observation of facts; here, you see, we have got a fact which I did not want, for it was my intention that the marble which had been heated should not effervesce. Now, in science we must interpret the language of facts as they arise. This is an awkward fact; why did it happen? It was because we did not allow the action of the heat to continue sufficiently long. We shall have to go over the experiment again, but for the present you must take my word, that if the marble had been ignited sufficiently long it would no longer have been able to effervesce. I will give you another illustration of the great amount of heat that is produced by this residue when it is wetted. Here we have some large pieces of the residue left after ignition, and upon moistening them we shall get a very considerable amount of heat evolved. You will see the mass begin to steam in a minute or two. It already gets very hot; and if I place upon this mass of residue that has been left after the ignition of marble, a piece of phosphorus, you will see that the phosphorus will, in a minute or two, burst into flame. You see the phosphorus now takes fire from the heat that is in this way produced by wetting with water the residue left by the ignition of the marble. Thus you see that the substance which is left by the ignition is a very different substance from the original marble with which we began the experiment. Now we will take a little more of this marble residue, which we will also wet with water, and we will notice whether or not any other remarkable effect takes place through the action of the water. We here take our marble which has been burnt, and we will notice whether or not we get any solution; and for that purpose we will treat this liquid which we pour upon it exactly in the same way as we treated the liquid

that was obtained by the action of water upon the marble before it was burnt—that is to say, we will filter it—and then we will take the liquid obtained by the action of water upon the residue of the ignition of marble, and ascertain whether or not water, which would not take up anything from the original marble, will take up anything from this residue of ignited marble. Here I have some of this solution being made—it is filtering through the funnel; but here I have some of the solution already made. First of all we will try its effect upon this piece of paper. Here is a piece of paper almost colourless: we dip it in the solution, and we find that it is dyed almost purple, showing that the water which has been obtained in this way has got something in it. Here is another piece of paper; let us see whether the solution has any effect upon that. You will observe, on my taking out this piece of paper, that, whereas the first piece was stained of a bright red colour, this piece is very quickly stained green—not, I think, so decided a green as the other was a decided red, but still I think it is very apparent; you see, then, that the product obtained by the action of water upon the residue of ignited marble has certain properties. Here we have another piece of paper, and you see that it is dyed brown by the action of the liquid. Here we have a piece of paper which is already red, and on our allowing this to come into contact with the liquid it becomes of a decided blue colour. In this way, then, we are able to ascertain that the liquid that filters away from the residue of the ignition of marble has the property of effecting these bodies in these different ways. But we will try its properties in another way. Here are some vessels containing certain metallic solutions. You will find that the water which has been allowed to digest on marble which has not been ignited, has no effect on the solutions, except that it makes them of a somewhat paler colour by diluting them; whereas I hope to show you that the water from the marble after it has been heated, has a very decided effect. [Portions of the liquid filtered from the calcined marble were added successively to the various metallic solutions.] Here we get a blue precipitate; here we get a black precipitate. To this we add some of the liquid in the same way, and we get a brown; into this, again, we put some of the liquid from the ignited marble, and we get a green; here, again, we get an orange colour. Lastly, we add some to this solution in the same way, and we get a white precipitate. Hence you see that, while the water filtered from the unburnt marble has no effect upon these solutions, the water which has acted upon the marble after ignition produces a very decided effect.

Now, what is the nature of this substance which is left behind after the ignition of the marble? Well, this residue is known as "quick lime." When you heat marble in this way you get a substance which differs very much from the original marble; it is no longer marble at all; it has not the property of effervescence with acids, but it has the property of forming a solution with water and giving out heat when moistened. Marble is a substance which does not give out heat on being wetted, and does not dissolve; marble effervesces with acids, but the quick-lime does not. So much, then, for the residue.

Now, what is the nature of the gas that is produced when the marble is heated and the residue of quick-lime is obtained? Here is an arrangement for obtaining the gas rather more convenient for lecture purposes than the one we employed before. It is exactly of the same character, only in this we have the marble in a separate vessel, and the acid can act upon it at leisure. Here we take some of our lime water, and we cause some of this gas to bubble through it, and we notice what effect takes place. When we allow the acid to come into contact with the marble we get an abundance of the air or gas given off, and we found that the same air or gas was given off by the marble whether through the action of acid or of heat. We allow some of this gas to act upon this lime water, and we find that we get a substance identical with the original marble with which we started. We will try this product, and I have no doubt those who are near me will see that a gas is given off when I add muriatic acid to it. [The precipitate effervesced on being treated with acid].

From what we have seen, then, we conclude that the lime differs from the original marble in the absence of this particular kind of gas or air which the marble gives off when it is heated, and you noticed just now that when we caused this gas to combine again with the lime we got a substance possessing the properties of the original marble; and if we took this precipitate from the lime water and acted upon it with muriatic acid, you saw that we got the gas once more driven off, and the precipitated marble dissolved. The precipitate which was produced we say is chemically the same thing as marble.

Now let me call your attention to some other kinds of marble. Here is a piece of coral; here is a piece of stalactite; here is a piece of calcareous spar; here is a piece of limestone; and here is a piece of shell. If we take, for instance, some of these shells, and cover them with water, and act upon them with muriatic acid, we shall get in this case, as in the other, a considerable amount of effervescence, due to the solution of the shells in the acid and the giving off of a gas. Directly we pour some of this acid upon them, the shells undergo solution, and immediately

they effervesce. Well, not only will shells or limestone act thus, but also pearls. For instance, if we take some pearls and act upon them with hydrochloric acid we shall find that the pearls dissolve and give off gas. I have spoken of this gas as being the gas of marble; I might equally well call it the gas of pearls. We moisten these pearls with water, and act upon them by muriatic acid, and we get in this case a rapid effervescence, and in this way we might collect the gas given off by pearls. You will remember, I dare say, the story of Cleopatra melting her pearl ear-rings in vinegar; well, all I can say is that either her vinegar must have been extremely strong, or she must have taken a very considerable time about it, for pearls dissolve very slowly in vinegar, though they dissolve more readily in this strong muriatic acid. We will facilitate the action of the muriatic acid upon the pearls by the application of a gentle heat, for, in the case of the pearls, although the substance is chemically identical with marble, it is in so compact a state that even the muriatic acid acts upon it very slowly, and the vinegar which Cleopatra employed scarcely acts upon it at all. Here we are collecting our gas from the pearls, and the action will go on in this way until we get our cylinder full of the gas.

I now want to call your attention, for the two or three minutes that remain, to some of the properties of this gas; first of all with reference to the combustion of metals in it; for although the gas given off from marble is not capable of supporting the combustion of ordinary combustibles, nevertheless it can support the combustion of some bodies. In the first place, in order to prove to you that metals will burn, I will show you the combustion of certain metals in air, and then we will take one of them and burn it in the same manner in the gas given off from marble.

I will here ignite some zinc, and then blow a current of air upon it, and you will find that in this way the zinc burns very readily in a current of air. Zinc, then, is a metal capable of burning very readily in air. Now let us try the combustion of the metal magnesium in the air; you have seen that metal burn in the air on several occasions. Here is a piece of magnesium burning in the air very readily and with considerable brilliancy. Now I want to show you the combustion of a metal, both in air and in the gas given off from marble, and that metal is not either of these that we have yet considered; it is the one which I am now about to ignite—metallic sodium. It is now beginning to burn with very great brilliancy, and whilst it is burning let me draw your attention to the remarkable appearance which that coloured diagram presents when illuminated with the light given off by burning sodium. What were seen to be brilliant colours when the magnesium was burning, now look perfectly black under the influence of the sodium light.

The only other experiment to which I wish finally to call your attention, is the combustion of this metal—sodium—not in ordinary air, but in the particular kind of air that is evolved from marble. We take, here, our apparatus which is giving off the gas from the marble, and we cause this gas to flow through pumice-stone, moistened with oil of vitriol for the sake of rendering it dry, and then we will receive it into this flask. We next heat our sodium as we did just now, except that instead of heating it in the open air we will heat it in the flask in a current of this gas, and I want to show you then what the effect will be. [A piece of sodium was deposited in a flask which had been filled with the dried gas; the sodium was then ignited by the application of a blow-pipe flame to the exterior of the flask]. The sodium has now, you see, taken fire, and is burning in the gas contained in the flask; and now the only other point that I have to call your attention to is the result of this burning. When we come to examine the contents of the flask, what do we find as the product of the combustion of the sodium in the gas evolved from marble? As soon as the mass at the bottom of the flask ceases to be red hot, I will call your attention to its appearance. You now see that we have here a solid mass of that black substance—charcoal—to which I directed your attention in the beginning of the lecture. Well, now, where did this piece of charcoal come from? This piece of charcoal could not have come out of the sodium, and for this reason,—that if you take this metal and burn it in the air, or in any other gas or under any of the conditions under which sodium is capable of burning, in no case do you get this charcoal except when it is burnt in this gas which is given off by marble. The point, then, to which we have arrived at the conclusion of this lecture is—that marble is capable of giving off a certain kind of air or gas, and that this air or gas contains charcoal as its essential constituent.

Professor Kopp.—From a letter just received from Professor Emile Kopp, we understand that he is on the point of quitting Saverne to reside at Turin, where he has been appointed Professor of Technological Chemistry and of Metallurgy in the Royal Museum of Italian Industry. Large laboratories are about to be erected under his superintendence, in which practical work will supplement theoretical teaching. We understand that these appointments have been offered to Professor Kopp by the Italian Government, and he has been induced to accept them in the expectation of having more time at his disposal for original research. After some remarks concerning the Chemical News highly flattering as coming from such an eminent chemist, he promises to forward occasional contributions from his laboratory and records of the progress of science in Italy.

ON THE

IMMEDIATE ANALYSIS OF METEORIC IRONS.*

By STANISLAS MEUNIER,
Aide Naturaliste at the Museum of Paris.

(Concluded from page 5.)

IV. Schreibersite.

I prepare schreibersite, or phosphide of iron and nickel, by the same method as troïlite.

Besides, as for the latter, it is always preferable to take the schreibersite in the places where it is naturally concentrated.

It is a metallic matter, yellowish or almost white. Its specific gravity is 7·103, and I have found in the schreibersite of Toluca's iron :—

Iron	57·11
Nickel	28·35
Cobalt	trace
Magnesium	trace
Phosphorus	15·01
	100·47

These numbers lead to the formula Fe_4Ni_2P, yet admitted by Mr. Smith after the analysis of the Tazewell's schreibersite. My confirmation is the more interesting in that Bergemann, analysing the same substance as I, but impure, found—

Iron	87·0
Nickel	9·5
Phosphorus	3·5
	100·0

Schreibersite is magnetic, and takes permanent polarity by contact with a magnet. It is brittle. Hydrochloric acid has no action upon it. Crystalline forms have not as yet been observed.

V. Graphite.

Graphite may be isolated by the following method :—A few grammes of metallic powder are projected into fused potash, and thus a mixture of nickeliferous iron and graphite is obtained. This mixture may be treated in several ways.

1st. Iron is dissolved in chlorhydric acid, which leaves as residue the graphite almost pure.

2nd. The graphite is separated by lixiviation. This process presents the advantage of giving both graphite and nickeliferous iron; but the separation is never complete.

3rd, and lastly. The magnet may be employed only when the graphite is abundant; in other cases it is drawn up with the metal.

In all cases the residue is washed by chlorhydric acid to dissolve foreign matters, such as troïlite and schreibersite, or what results from their being attacked by fused alkali.

The graphite extracted from the Caille iron shows a density equal to 1·715. Its analysis gave—

Carbon	97·3
Iron	2·4
Nickel	trace
	99·7

The graphite of the Charcas iron has a density of 1·309, and this is the result that I have obtained in its analysis :—

Carbon	98·0
Iron	0·9
	98·9

The graphite is remarkable on account of its great unalterability.

VI. External Crust.

The portions of meteoric iron, upon which is the crust, being separated by means of a saw, they are placed in a concentrated solution of bichloride of mercury. After a sufficient time all metallic particles are dissolved, and the oxides, amongst which is the crust, remains alone.

However, the crust is still mixed with foreign matters Usually there is with it the products of its alteration by atmospheric agents, and particularly limonite. Some schreibersite, troïlite, and stony grains may be also mixed with the principal substance, and their separation is very difficult.

Weak chlorhydric acid carries away limonite and troïlite; stony grains remain as residue after the action of the magnet; lixiviation permits the purification of the crust from schreibersite.

Besides, these operations may be simplified by choosing the portions of the crust that seem almost pure. They frequently detach themselves from the subjacent metallic matter.

Very few chemists have analysed the external crust of meteoric irons. The analyses given by Pugh, as showing the composition of the crust of the Toluca iron, have evidently been executed on an impure mineral. As it is precisely the crust that I have examined myself, I will record Pugh's results :—

Metallic iron	18·717
Protoxide of iron	19·309
Sesquioxide of iron	32·750
Protoxide of nickel and of cobalt	5·751
Chalk	trace
Silicates	10·203
Water	13·270
Chlorine	trace
	100·000

Evidently metallic iron, silicates, and water are not essential elements of the crust, and must be considered as impurities.

Having purified as much as possible by the method above described the crust of Toluca iron, I have found for it a density of 4·89, and the following composition :—

Sesquioxide of iron	6·893
Protoxide of iron	28·12
Protoxide of nickel	2·00
Protoxide of cobalt	trace
	99·05

These numbers agree with the formula Fe_2O_3, (FeNi)O, which does not differ from that of magnetite, except by the substitution of a small portion of nickel for a corresponding quantity of the iron of the protoxide.

It is remarkable that, if in Pugh's analysis we only consider sesquioxide of iron, protoxide of iron, and protoxide of nickel and of cobalt, we arrive at numbers very near to those required by the above formula.

VII. Stony Grains.

Several of the operations described above may evidently serve to prepare the stony grains in a state of purity. But this is how the separation must be made when it is especially intended to obtain these grains.

Iron in form of lumps is left protected from the contact of the air in a concentrated solution of bichloride of mercury, and frequently stirred. After a sufficient time the metal disappears, and the liquid contains stony grains mixed with protochloride of mercury, and generally with a small quantity of metallic mercury. There is also troïlite, schreibersite, and graphite. A solution of chlorine carries

off the calomel, and the magnet isolates the schreibersite and the troïlite; lixiviation may be employed to get rid of graphite.

In certain cases, time can be saved by submitting to the action of a current of hydrogen the magma produced by the action of the bichloride. Heat carries off the calomel, the mercury, the troïlite, and the schreibersite. The stony matter is purified from graphite by lixiviation.

If the stony grains (as is the ordinary case) are not oxidisable, hydrogen may even be replaced by air, which burns the carbon and gives directly the stony grains perfectly pure.

These grains are of different composition, and it appears that there exists a certain relation between their composition and their situation. Some are localised in the iron; others are situated in the troïlite, or, perhaps, in the graphite which surrounds this sulphur.

The grains of the first category may be found in meteoric irons of Tazewell and of Tuczon. They are formed of peridote, which is proved by the analysis published by Mr. Lawrence Smith. I have studied those grains, and found that their density is equal to 3·3. I have not observed crystalline forms.

The grains of the second category were given by the troïlite of the Caille iron. Their quantity was too small for me to be able to analyse them, but I have submitted them to the blowpipe assay. Those grains are not fusible, and gave nothing but the reaction of silica.

The troilite of Charcas iron gave me analogous results.

VIII. Gases.

Gases have been recognised in the meteoric iron of Lenarto, by M. Boussingault and by Mr. Graham.

I have sought the same bodies in another iron of the same origin by means of the solution of those masses in concentrated bichloride of mercury. The results were that gases do not exist in appreciable quantity in the iron of Caille and of Charcas. The mass of Krasnojarsk (Siberia) gave me a small bubble of gas, having the composition of atmospheric air; but it must be remarked that this iron was cracked.

IX. Rare Substances.

In concluding this enumeration, I must mention chromite and protochloride of iron, which appear in certain irons. Their separation is evidently easy, and their composition is identical with that of analogous terrestrial compounds.

After having described the methods which have permitted me to separate in a state of complete purity the *immediate principles* of meteoric irons, I will remark that those methods can be employed to estimate the relative quantity of the substances in question.

I have, for instance, submitted to a *quantitative immediate analysis* the meteoric iron discovered in 1784, at Xiquipilco, in the valley of Toluca (Mexico), and I have found in it—

Nickeliferous iron	96·301
Graphite	1·176
Troïlite	1·482
Schreibersite	1·232
	100·191

I will remark upon this subject that those numbers are exact exclusively for the analysed specimen. In other parts of the same mass, crust, stony matters, &c. may be found, and perhaps some of the above-named principles can disappear.

I will show in another paper how my studies have given me a good rule for the classification of meteoric irons.

Paris, November 27th, 1868.

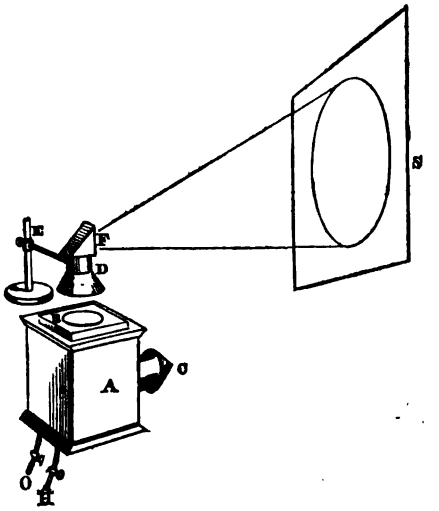
ON THE

EXHIBITION OF COHESION FIGURES TO A LECTURE AUDIENCE.

By C. J. WOODWARD, B.Sc.,
Lecturer on Chemistry and Physics, Midland Institute, Birmingham.

Wishing to exhibit the singular figures discovered by Professor Tomlinson, and known as cohesion figures, I proposed adopting the method mentioned by Mr. Reynolds in the CHEMICAL NEWS of November 27th; but it occurred to me that an arrangement similar to that used to show waves in water would probably serve the purpose. I therefore tried the following plan, which, though not so successful as the one I shall afterwards describe, is well worth trying:—A box with a glass bottom was filled with water and a lime light placed underneath the box. On throwing a spot of liquid, giving a cohesion figure, on to the water, the figure, more or less definite, was exhibited on a tracing paper screen placed above the box. Even with a candle underneath the box the figures were visible, but of course not sharp as when the oxy-hydrogen light was used. This experiment led me to devise the following arrangement, which, with such liquids as I have tried, serves admirably, the figures being projected on to the screen with great clearness:—

In the first place several troughs are made to hold the water on which to place the creosote, &c. Those I have are made of plate glass. A piece of glass 5 inches square and ¼ inch thick has a hole 3 inches diameter cut in it, and this, when laid on a plain piece of glass, forms a circular trough, 3 inches diameter and ¼ inch deep. An ordinary oxy-hydrogen lantern, from which the nozzle has been removed, is now tilted back so that the light from the lantern is thrown perpendicularly upward, and the trough placed just over the front of the lantern as though it were a lantern slide. The nozzle of the lantern, fitted to a projecting arm, is then brought over the trough and an image of the upper surface of the water obtained on the ceiling. On now placing a drop of creosote on the



water an image of it is seen on the ceiling. If it be desired to throw the image on to a vertical screen, a reflecting prism is placed on the nozzle, by which the desired effect is obtained.

The arrangement will be completely understood by referring to the accompanying figure, in which A is the lantern turned back; C, the chimney; B, the glass trough to hold the water on which the creosote or other liquid is

placed; D, nozzle of lantern, supported by the horizontal arm E; F, reflecting prism; S, screen on which the image is received.

It should be mentioned that it is necessary to remove the usual taper pipe of the nozzle of the lantern, and substitute a shorter one, so that the figures may be properly focussed, and yet room enough left to introduce a pipette between the nozzle and the trough containing the water.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Sulpho-acids of the Hydrocarbons C_9H_{12}.—O. Jacobson has examined the sulpho-acids and their salts of the isomeric hydrocarbons C_9H_{12}, and he has found that they are sufficiently distinguished from each other to serve as means for identifying the hydrocarbons. Cumol, prepared from camphorone by the action of fusing zinc chloride, although its formula appears to be C_6H_5 (C_3H_7) (Fittig, *Ann. Chem. Pharm.*, cxii., 309), differs from propylbenzol (derived from cuminic acid). A statement, Church's, that a hydrocarbon of the formula C_9H_{12} was formed by dry distillation of barium eugenate, the author has not been able to confirm.—(*Ann. Chem. Pharm.*, cxlvi., 85.)

Composition of the Crystals of Sodium Ethylate.—A. Geuther and E. Scheitz.—The transparent crystals which are obtained by dissolving sodium in absolute alcohol and allowing the heated solution to cool, have the composition $C_2H_5NaO.2C_2H_6O$. They are soluble in either. In a vacuum over sulphuric acid they gradually loose the two molecules of alcohol, and are converted into sodium ethylate, C_2H_5NaO.—(*Jen. Zeitschr., F. M. and N.*, iv., 16.)

Formation and Constitution of Racemic Acid.—A. Strecker. In consequence of the relation existing between succinic and tartaric acid, the constitution of the latter (and doubtless also of paratartaric and the other modifications of tartaric acid) may be inferred from that of the former. Various formulæ for tartaric acid are possible according to whether the part C_2H_4 in succinic acid be considered as ethylene or ethylidene. If succinic acid is—

$$\begin{array}{l} CH_2.CO.OH \\ | \\ CH_2.CO.OH \end{array}$$

tartaric acid will be—

$$\begin{array}{l} CH(OH).CO.OH \\ | \\ CH(OH).CO.OH \end{array}$$

or it might be—

$$\begin{array}{l} C(OH)_2.CO.OH \\ | \\ CH_2CO.OH \end{array}$$

but if the constitution of succinic acid is—

$$\begin{array}{l} CH_3 \\ | \\ CH.(CO.OH)_2 \end{array}$$

then a number of formulæ for tartaric acid may be set up, in all of which, however, the two atoms of carbonyle would be attached to the same carbon atom. Assuming the first formula of tartaric acid to be the correct one, the author endeavoured to obtain that acid from glyoxal,

$$\begin{array}{l} COH \\ | \\ COH \end{array}$$

by the introduction into it of H.CO.OH, *i.e.*, by treatment with hydric cyanide and chloride. On mixing an aqueous solution of glyoxal with an excess of cyanhydric acid and some chlorhydric acid, boiling for several hours, evaporating on the water bath, and adding to the residue milk of lime, a calcium salt is obtained which is partly soluble in acetic acid. The insoluble portion was converted into lead salt, and this decomposed by hydric sulphide. The acid solution thus obtained gave, on evaporation, crystals of racemic acid, $C_4H_6O_6+H_2O$. The acid is formed according to the following equation:—$C_2H_2O_2 + 2CNH + 4H_2O = C_4H_6O_6 + 2NH_3$. By this synthesis the constitution of this modification of tartaric acid is proved to be the following:—

$$\begin{array}{l} CO.OH \\ | \\ CH.OH \\ | \\ CH.OH \\ | \\ CO.OH \end{array}$$

An analogous structure no doubt belongs to the other modifications of tartaric acid.—(*Zeitschr., Ch., N. F.* iv., 216.)

Nitroglycerin.—F. Tilberg. Nitroglycerin (from the works at Stockholm) is decomposed when acted upon by potassium hydrate; amongst the products of decomposition are potassium nitrate, glycerin, ammonia, cyanogen, oxalic, humic, and nitrous acid. When ignited in a vacuum with copper oxide and copper, 2 vols. of carbonic anhydride, and 1 vol. of nitrogen are obtained, from which numbers the formula $C_3H_5(NO_2)_3O$ is deduced. Nitroglycerin dissolves in concentrated sulphuric acid, forming with it a new compound acid which yields crystalline salts. A combustion gave 3 vols. of carbonic anhydride to 1 vol. of nitrogen. If nitroglycerin is regarded as a substituted glycerine, and the relation between it and the new acid the same as that between glycerin-sulphuric acid, and glycerin, the new compound will be dinitroglycerin-sulphuric acid.—(*Oefvers. af Akad., Förh.*, 1868, 25, No. 2, 75, *and Journ., p. Ch.*, cv., 254.)

OBITUARY.

Mr. George Lowe, F.R.S., the eminent Gas Engineer, died on Christmas Day at his residence at Finchley. He was elected an Associate of the Institution of Civil Engineers in 1823, transferred to the class of members in 1829, and for some years was a most useful member of the Council. His name is connected with many improvements in gas engineering, the most prominent being his system of reciprocating retorts and his motive-power meter.

On January 4th the death of James Edward Forbes, D.C.L., LL.D., F.R.S., late Principal of the United Colleges of St. Salvador and St. Leonard's, St. Andrew's, was announced. The deceased, who was a son of the late Sir William Forbes, Bart., of Pitsligo, was born in Edinburgh in 1809, and was educated at the University of Edinburgh, where he obtained several prizes and where he held the professorship of Natural Philosophy from 1833 till 1860. In 1832 he was elected a Fellow of the Royal Society, and received the Rumford and Royal Medals; he also gained the Keith Medal of the Royal Society of Edinburgh, of which society he was Vice-President. He was the author of a number of works on physical science, as well as of works in various departments of general literature, some of the most noted being "Papers on the Theory of Glaciers," "Norway and its Glaciers," and "Travels in the Alps of Savoy."

CORRESPONDENCE.

ON THE FUMING OF CERTAIN ACIDS.

To the Editor of the Chemical News.

Sir,—I was struck by the inquiry of a student in a late number of the Chemical News, why hydrochloric acid fumes when let out into the air, while ammonia, which has a much stronger attraction for water, does not?

If the student continues to read his chemistry with the same inquiring spirit that prompted this question, he will not only become a good observer himself, but he will have an influence in making our text-books better exponents of observation than some of them are, in many respects, at present.

It is not an unusual fault that our books contain too many bald facts often adopted without sufficient verification, and too little reasoning. Facts are good soldiers; theory a good general; but unless they work together, there is very little real fighting.

But to the point. Why does not ammoniacal gas fume when let out into the air?

I took the specific gravity of a solution of ammonia and found it to be 0·889. Twenty-four drachms of this were put into a flask and heated over a spirit lamp. It at once entered into brisk ebullition, and there was a great head of gas bubbles from which very large bubbles expanded and burst. The thermometer rose slowly to 100° F. When the lamp was removed the boiling ceased instantly, but two or three rapid streams of small gas bubbles continued to be discharged for some time from black specks in the glass, which acted as nuclei. When the temperature was at 160° the lamp was removed, and the solution left to cool. It still smelt of ammonia; the lamp was replaced, and no gas bubbles were given off until the temperature had again risen to about 160°. The appearance of ebullition was much less marked than before, and the temperature rose to 208°, at which it became stationary (Barometer, 28·69 inches). When cold, only 10 drachms remained of the 24. The specific gravity was now 0·997. The liquid had a faint smell of ammonia and a slight action on turmeric paper; but on putting the glass into another room, where the liquid could not re-absorb ammonia, it lost, in the course of some hours, all smell; it had no action on turmeric paper; it was, in fact, brought back to pure water.

If a similar experiment be made with a strong solution of hydrochloric acid, it will be found impossible to boil away all or nearly all, the acid gas. If we operate on the acid solution of specific gravity 1·21, it will part with gas until it has a density of 1·10 (at 60°), when it will have a boiling point at 233° F., and will distil unchanged.

We see, then, that although ammoniacal gas and hydrochloric acid gas are greedily absorbed by water, there must be some important differences in the constitution of the respective solutions. We have seen that the alkaline solution is much lighter than its own bulk of water, the acid solution much heavier; that the presence of ammoniacal gas in water lowers its boiling point, while the presence of hydrochloric acid in water has a contrary effect. Hence the mode of combination between ammonia and water must be different from that between hydrochloric acid and water. The one must be a case of simple adhesion, the other of true chemical combination as well as adhesion.

Ammonia let out into moist air, simply adheres to the moisture and increases its volume. Vapour of alcohol, ether, &c., does the same. Now any amount of aqueous vapour that the air can maintain in an invisible elastic state, at a given temperature, it can maintain with increased effect in the case of ammonia vapour, alcohol vapour, &c. Hence the combination of these vapours with the moisture of the air is necessarily an invisible compound.

Hydrochloric acid gas, on the other hand, let out into the air, combines chemically with the moisture, producing condensation or diminution of bulk. Hence the compound is visible just as the condensation of pure steam in air produces visible vapour.

Fuming nitric acid and Nordhausen sulphuric acid are also cases in point. Concentrated nitric acid exposed to the air absorbs moisture until it attains the density of 1·424, when it distils unaltered at a boiling point of 250°.—I am, &c.,

C. Tomlinson.

Highgate, N., Dec. 28, 1868.

MISCELLANEOUS.

Sale of Poisons Act.—A very important act of Parliament—the Amended Pharmacy Act, or Sale of Poisons Bill—came into operation on the 1st inst. By this act it is directed that on and after the 1st day of January, 1869, no poison shall be sold by any person except those registered according to the acts now in force as pharmaceutical chemists, or chemists and druggists; and that every box, bottle, vessel, or wrapper containing poison shall be distinctly labelled with the name of the article, together with the name and address of the person selling the same. A schedule of poisons is given, divided into two sections. All those in section A are strictly forbidden to be sold to any person not known to the seller, unless introduced by some person known to the seller; a register of the sale is compulsory, and must be attested by the signature of the purchaser and his or her witness; while those poisons included in section B need only to be properly labelled. All medicines must be compounded with articles prepared strictly according to the *British Pharmacopœia*; and every adulteration of any article retailed shall be deemed an admixture injurious to health, punishable under the provisions of the Act for Preventing the Adulteration of Articles of Food or Drink. The poisons defined by this act are—in Part 1, arsenic and its preparations, prussic acid, cyanides of potassium and all metallic cyanides, strychnine and all poisonous vegetable alkaloids and their salts, aconite and its preparations, emetic tartar, corrosive sublimate, cantharides, savin and its oil, ergot of rye and its preparations; and in Part 2, oxalic acid, chloroform, belladonna and its preparations, essential oil of almonds, unless deprived of its prussic acid, opium, and all preparations containing opium or poppies. Among the preparations which, according to this act, will have to be labelled as a poison, we notice paregoric elixir, child's cordial, syrup of poppies, and every other syrup, tincture, or lozenge which shall contain the smallest portion of opium or morphia. The object of this Bill is evidently to prevent ignorant persons from dealing in articles the composition of which they do not understand. It will also serve as a check to the poisoning of children by the administration of such preparations as child's cordial, soothing syrups, &c. The fine for selling these articles without being properly labelled is heavy, as it is also for selling them without being properly licensed.

The Gas Supply of the City.—In the month of July of last year an important act of Parliament was passed for improving the quality of the gas supplied to the City of London by the several City Gas Companies, and also to those parts of the Metropolis supplied by the Chartered Gas Company, whereby the quality of the gas was raised from a standard of twelve candles to fourteen, without increase of charge to the consumer; and with the view of securing the provisions of the act, and enforcing penalties in all cases of default, a chief gas examiner is appointed by the Board of Trade to receive the reports of the daily testings of the gas and to decide all matters of dispute respecting the quality of the gas. It is also the duty of the chief gas examiner to report to the corporation, to the

Metropolitan Board of Works, and to the several companies the quality of the gas supplied during the quarter; and in this capacity, and in accordance with the provisions of the 71st section of the City of London Gas Act, 1868, Dr. Letheby has recently submitted his report to the Corporation of London, from which it appears that since the act came into operation, on the 1st of October last, the gas of the several companies supplying the city has been tested every night at intervals of not less than an hour between the hours of five o'clock and ten o'clock. The results are as follows:—

Illuminating Power in Standard Sperm Candles.

	Maximum.	Minimum.	Average.
City of London Gas Light, and Coke Co.	16·30	13·99	15·13
The Chartered Gas Light, and Coke Co.	16·36	14.13	15·26
The Great Central Gas Consumers Co.	16·64	13·46	14·90

It appears, therefore, that the illuminating power of the gas has ranged from 13·46 candles to 16·64—the average for the quarter being 15·13 candles for the City Company, 15·26 for the Chartered, and 14·90 for the Great Central. The daily returns show that on three occasions only the gas has been below the standard, and these were no doubt due to causes which admit of satisfactory explanation. With regard to the purity of the gas, he reports that the gas of the Chartered and Great Central Companies have always exhibited traces of ammonia, but that the gas of all the companies has been constantly free from sulphuretted hydrogen. The amount of sulphur present in the gas has ranged from 7·9 grains to 26·52 per 100 cubic feet, the proportion of this impurity being as follows:—

Grains of Sulphur per 100 *Cubic Feet of Gas.*

	Maximum.	Minimum.	Average.
City of London Gas Light, and Coke Co.	22·28	10·64	16·89
The Chartered Gas Light, and Coke Co.	26·52	11·01	21·93
The Great Central Gas Consumers Co.	24.94	7.90	14·24

The smallest amount of sulphur has been in the gas of the Great Central Company, and this is attributed by Dr. Letheby to the excellent system of purification adopted by that company. The proportions of sulphur have been determined by the instrument known as Dr. Letheby's sulphur test, which is that recommended for use by the gas referees appointed under the act. It is extremely desirable that this impurity should be reduced to the smallest quantity, on account of the corrosive action of the products of its combustion.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Comptes Rendus.

October 5, 1868.

Chevreul, "Researches on Experimental Methods in Chemistry." Croullebois, "On the Dispersive Power of Gases and Vapours." Dumas, "Note on Drechsel's Method of Preparing Oxalic Acid from Carbonic Acid." M. Boucherie, "Note on the Preservation of Wood." A. Houzeau, "On Testing Campeachy Wood and other Dye Stuffs." N. Zinin, "Contributions to the Knowledge of the Stilbene Series." Hiortdahl, "On the Native Alloys of Gold and Silver from the Kongsberg Mine, Norway." A. Gautier, "On Isopropylcarbylamine and Isopropylamine." J. Ney, "A New Galvanic Battery.

October 12, 1868.

E. Frankland, "On the Combustion of Hydrogen and Carbonic Oxide in Oxygen under a High Pressure." J. Kolb, "Memoir on Bleaching Fabrics." G. Rayet, "On the Spectrum of the Protuberance observed during the Total Eclipse of the Sun of August 18, 1868, at Malacca. J. Clouet, "On Chromite of Iron." E. Paterno, "On the Acetal of Trichlorinated Ethyl, and on the Preparation of Chloral."

October 19, 1868.

Dumas, "Note on a Decision of the Academy relating to Memoirs on Squaring the Circle, Duplication of the Cube, Trisection of the Angle, and Perpetual Motion." Warren de la Rue and H. Muller, "On a New Constant Battery." Rapatel, "Report on the Eclipse of the Sun of August 18, 1868, from Observations taken between Madras and Calcutta." A. Gautier, "On the Oxidation Products of Carbylamines." De Saint-Martin, "On the Density of Saline Solutions.

Bulletin de l'Académie Imperiale des Sciences de St. Petersbourg.

June 4, 1868.

P. Kostyttschef and O. Marggraf "On the Chemical Composition of the Fossil Sponges of the Apatites of the Cretaceous Beds of Russia." N. Zinin, "Note on Chloro-benzil." Duke Nicholas von Leuchtenberg, "Note on Kotchoubeite, Kämmererite, and Pennine." H. Jacobi, "On the Electro-Deposition of Iron." Klein, On the same subject. O. Strune, "On the Spectrum of the Aurora Borealis." A. Famintzin, "On the Action of Light on Cell-division in Spirogyra."

Annales de Chimie et de Physique.

September, 1868.

P. Audouin, "On the Use of Liquid Hydrocarbons for obtaining High Temberatures and for Heating Steam Boilers. A. Renard, "On the Volumetric Estimation of Zinc." E. Bourgoin, "On the Part taken by Water in Electrolysis." A. Martin, "An Improved Process for Silvering Glass by means of Inverted Sugar." P. Schutzenberger, "On some Reactions producing Oxychloride of Carbon, and on a New Volatile Platinum Compound." De Lapparent, "Report on Pasteur's Method of Preserving Wine by means of Heat." P. Schutzenberger, "Memoir on the Colouring Matters extracted from Persian Berries."

Bulletin de la Société Industrielle de Mulhouse.

July, 1868. Supplement.

J. Kolb, "Memoir on Bleaching Fabrics." H. Kœchlin, "On some Mordants, other than Alumina and Iron, for Garancine Colours, with especial reference to a new Red (*grenat*) Dye obtained with Chromium." A. Scheurer-Kestner and C. Meunier, "Researches on the Combustion of Coal." C. Kœchlin, "A Process for Extracting the Colouring Matter from Waste Fabrics Dyed with Garancine." M. Paraf-Javal, "Note on a Method of Preventing the Injurious Action of Aniline Black on the Copper of Printing Rollers." Schneider, On the same subject. Marnas, "A New Aniline Dye."

NOTES AND QUERIES.

Vitriol Chamber.—What is the best shape for a vitriol chamber, and on what does the yield depend? I wish to know whether a chamber of the shape of a cube would yield as much as a longer and narrower one of the same contents?—G. N.

MEETINGS FOR THE WEEK.

Monday, 11th.—Medical, 8.
—— London Institution, 6.
Tuesday, 12th.—Royal Institution, 3. Prof. Westmacott, "On Fine Art."
—— Photographic, 8.
Wednesday, 13th—Geological, 8.
Microscopical, 8.
Thursday, 14th.—Royal Institution, 3. Mr. Rupert Jones, "On Protozoa."
—— London Institution, 6
—— Royal, 8½.
—— Zoological, 8½.
—— Royal Society Club, 6.
Friday, 15th.—Roval Institution, 8. Prof. Tyndall, "On Chemical Rays and Molecules."
Saturday, 16th.—Royal Institution, 3. Professor Odling, F.R.S., "On Hydrogen and its Analogues."

TO CORRESPONDENTS.

Mr. Bassett's communication "On a Mercury Compound of Acetylene," together with those of several other correspondents, are unavoidably postponed till next week.

Querist.—One part of sulphur will dissolve in about 2000 parts of glycerine, and we believe the solution has been proposed as a local application in some affections of the skin.

Oriens asks "whether there is, in the service of the Siamese Government, any opening for a technological chemist experienced in the analysis of soils, ores, furnace products, and drysalteries, and if so, what would be the channel for an applicant to offer his services?" Perhaps some of our correspondents may be able to answer this inquiry.

Communications have been received from W. F. Suffolk; H. Sanders; G. Marrison; J. Dicker; W. Salter; Dr. Letheby; O. Richter; J. Wilson; E. Kopp; L. Cookson (with enclosure); J. Pride (with enclosure); S. R. Muspratt; T. Vosper; A. N. Tate; T. Watts; J. Parnell; Dr. R. Angus Smith; Rivington and Co.; W. Macnamara; J. A. Brand; D. Forbes, F.R.S.; G. Young (with enclosure); D. W. Ladley; J. W. Sugg; and C. K. Jewett, Göttingen (with enclosure).

THE CHEMICAL NEWS.

Vol. XIX. No. 476.

ON THE CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(Adapted to a Juvenile Auditory),

delivered at the

ROYAL INSTITUTION OF GREAT BRITAIN,

(CHRISTMAS, 1868-9),

by

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE II.

Carbonic Gas—Air—Oxides.

Production of carbonic gas by combustions in air of charcoal, of coal, of wood, of candle, and of gas; also by processes of decay, of fermentation, of germination, and of respiration—Discharge of carbonic gas from earth-fissures and mineral springs—Invariable existence of carbonic gas as a constituent of air—Its proportion in the external air very small—Air a material substance, capable of being felt and of being weighed, or having the properties of extension and gravity—Consequences of the weight of air—Existence of different sorts or kinds of air, as ordinary air, fixed air, phlogistic air, vital air, inflammable air, &c.—Some kinds of liquids miscible, others immiscible with each other; but all kinds of air or gas miscible with each other—Ordinary air a mixture, chiefly of two distinct kinds of air—Absorption of about one-fifth of the bulk of ordinary air by different chemical actions, and especially by the rusting of metals, the burning of combustibles, and the breathing of animals.

I fear that in my last lecture I did not address myself sufficiently to those of you for whom this course of lectures is especially intended; that is a fault which I must try to mend upon this occasion. To-day, then, we will have the lecture entirely to ourselves, and disregard those full-grown people who sit upon the hinder benches. Now, as I am only going to talk to *you*, I shall not hesitate to venture upon a little recapitulation; and I wish to call your attention to some of the ground that we went over two days ago. You remember we began with marble. I told you that marble is characterised by certain very well-defined properties. It is not one of those substances which become hot when moistened with water; it will not dissolve in water, but it does dissolve in acids; and when it dissolves, the act of solution is attended by that particular kind of action which is called effervescence or frothing. Now you will remember that this effervescence really consists in the formation or liberation of a particular kind of air or gas underneath the surface of the water. Here is the solution of the marble in acid going on. You see it is accompanied with an effervescence, and this effervescence consists in the formation of bubbles of air or gas which we are collecting in this tube. Then we spoke of the action of heat upon marble; and you will remember, also, when the marble is heated very strongly—in this tube, for instance—that it gives out a quantity of air, and we find that the air which is given out from marble when subjected to a strong heat is identical with the air given off from marble by the action of acids.

I next proceed to examine the residue; of what does it consist? We find that the residue consists of quick-lime, and that this quick-lime differs from marble in several particulars.

First, unlike marble, directly we moisten it with water it becomes extremely hot; unlike marble, it dissolves in water, and forms the perfectly clear solution called lime-water. Lime dissolves in water, marble does not; and, unlike marble, the lime, when acted upon by acids, does not give off any kind of air or gas. We find, then, that marble, when strongly heated, is resolved into a particular kind of air or gas which we are here collecting, and into a residue of quick-lime capable of being dissolved in water.

Now what will happen if we take some of the gas evolved from the marble by the action of heat, or some of the gas obtained from the action of acids, and pass it through lime-water? Here you see we are separating our marble into quick-lime which remains behind, and this particular kind of air or gas which is being collected. Here, again, is the same kind of air or gas—generated in this case by the action of an acid, instead of by the action of heat—and we pass it through our lime-water, and re-obtain a substance which is no longer soluble in water. This substance is, in fact, the same chemical compound as the marble with which we began. In one apparatus we decompose marble into gas and quick-lime, and in the other apparatus we reform the marble by combining with the quick-lime the gas evolved from marble by the action of acids. But we may also form marble by using the gas evolved under the action of heat. If, instead of collecting the gas produced from the marble by the action of heat, we allow it to bubble up through this lime-water, you see that in this case, also, we reproduce, in a different form, the marble which we are decomposing by heat in the tube.

Now I call this precipitated substance "marble," but, of course, that is not strictly correct. This substance has the same com-

* Reported verbatim, by permission of the Author, for this Journal.

position as marble, but it is not marble itself, because we apply the name "marble," not to a substance which merely has the same chemical composition as marble, but to a substance having certain physical properties. You will remember that, on the last occasion we spoke about this piece of marble, I called your attention to the fact that it was a brittle substance; but this precipitate that we have got is no longer brittle; in fact, though it is the same thing *chemically* as marble, it is not the same thing *mechanically*. It is chemically the same thing as marble, in the same sense that shells are the same thing as marble. Shells, for instance, when they are acted upon by acid, dissolve in it like marble, and give rise also to the phenomenon of effervescence. Here we have a piece of coral dissolving in the acid with effervescence, and giving off exactly the same kind of gas as from marble; so that, although we have hitherto spoken of this gas as being the gas from marble, we might also call it the gas from shell, the gas from coral, the gas from limestone, or even the gas from pearls.

Now for a word or two about lime. Lime differs from marble in the fact that it does not effervesce when acids are added to it, and the reason of this you will very readily see. The gas which is given off by heating marble so as to leave the quicklime, is identical with the gas given off by the action of acids upon marble; and if we first drive off all the gas by heat, of course there is no more gas left in the marble to be driven off when we act upon it by acids. The marble so heated no longer effervesces with acids, because the whole of the air which it contained has been driven off by heat. In this way we learn that marble is a compound of the quicklime with the air or gas which is given off.

I told you that this precipitate was chemically the same as marble, and as such it ought to be dissolved by acids with effervescence, like the original marble. [Some muriatic acid was added to the water containing the precipitate suspended in it.] In this case you see we get a considerable amount of effervescence; there is a distinct frothing on the top of the water from the effervescence which is now taking place. Well, all these substances—shell, coral, pearl, this precipitated chalk, and limestone—are converted into quicklime by heating; and all effervesce with acids, giving off this particular kind of gas.

Now, what is the nature of this air which is given off? In the first place, we have seen that it has the property of rendering lime-water milky; in the next place we shall find that it has the property of extinguishing the flame of ordinary combustibles. To begin with, we will take this particular portion of gas which we first produced, and lower into it a burning rod of wood. You see the light is immediately extinguished; and not only will the flame of the burning wood be extinguished, but also the flame of burning gas. We introduce a jet of ordinary gas, and it is at once put out; we ascertain, then, that wood and gas are two substances which will not burn in the air evolved from marble. Let us try another substance. We will take this small piece of candle, and observe whether the same thing will happen to it. Our piece of candle burns perfectly well in ordinary air; let us see whether it will burn in the air from marble. We introduce it; the flame at once goes out. From this we learn that ordinary substances, at any rate, will not burn in the gas from marble.

But chemists, as I told you on the last occasion, are acquainted not only with ordinary combustibles, but also with extraordinary combustibles. Zinc, magnesium, sodium, and iron, although not usually regarded as combustibles, are, nevertheless, combustible in the eyes of the chemist; they have the property of burning in the air. Now this particular substance—sodium—not only possesses the property of burning, as ordinary combustibles do, in air, but it has also the property of burning in the gas from marble; and at the end of the last lecture, when heated in the gas from marble, this sodium not only burned with great brilliancy, but it produced a very extraordinary result. Here is the flask in which we performed the experiment, and we found in it a large piece of charcoal. Where did that charcoal come from? It did not come from the sodium, as we know, for this reason: you may treat sodium in all sorts of ways—burn it in the air, or in a variety of gases; but do what you will with it you cannot get any charcoal out by means of it, unless you employ some substance which, like the gas obtained from marble, contains charcoal; and we may not only get charcoal from the gas by means of sodium, but by a variety of other substances, and therefore we are led to the conclusion that the charcoal came from the gas of the marble, and that this gas or air evolved from marble contains charcoal as an essential constituent.

I have hitherto called this gas "air or gas from marble;" I ought to tell you that it was originally called "fixed air," because it is capable of being fixed or absorbed by lime. It is now called "carbonic gas," because it is the air or gas from charcoal or carbon. Marble, then, is a compound of quick-lime with carbonic gas, and is called chemically "carbonate of lime."

The next thing to consider is whether, since we can get charcoal out of carbonic gas, we cannot produce carbonic gas from charcoal as well as from marble. First, let me explain to you the method of ascertaining the presence of this gas; the test used for this purpose is lime-water. The carbonic gas forms with the lime-

water an insoluble compound—chalk—and accordingly, when we find that a gas passed through lime-water converts it into the insoluble substance chalk, we know that we are dealing with carbonic gas—the gas containing charcoal. Now let us see whether we can get any of our carbonic gas produced from charcoal. Here is a tube passing into some lime-water; we draw some of the air from this burning charcoal through the tube into the lime-water, and the lime-water, which at first was perfectly clear, becomes converted into a mixture of chalk and water. We convert the lime into chalk, a proof that we are dealing with that particular kind of gas which has the property of rendering lime-water turbid, and thus we know that by burning this charcoal we are converting it into carbonic gas.

Now, carbonic gas is produced not only by the burning of charcoal, but also by the burning of other ordinary combustibles. Here are some bottles, which in the ordinary acceptation of the term are empty; that is to say, they are full of air and nothing else, and would be called empty bottles. We will first hold one of these bottles over an ordinary gas flame, and then pour into the bottle a little lime-water; we shake it up for a minute or two, and you see our lime-water is converted into chalk, and, therefore, we find that ordinary gas also has the property of forming this carbonic gas or fixed air. We will now try another combustible—a piece of wood. We take a piece of wood in the same way, and allow it to burn inside the bottle, and notice whether, under these circumstances, we obtain this carbonic gas. We will add to it some lime-water, and we shall find that our lime-water in this case, as in the other, becomes milky from the formation of chalk, showing that not only charcoal and coal gas, but wood also, when burnt, has the property of producing this particular kind of gas which we obtain from marble. We will now take another combustible. We will take a taper and burn it in the same way in this other empty bottle, and notice whether any carbonic gas or fixed air is produced; we observe that here, also, our clear lime water is converted into a chalky liquid. We find, then, that carbonic gas is thrown into the atmosphere by all ordinary burning bodies—by the burning charcoal, the coal gas, the wood, and by the taper.

Now, are there any other means by which carbonic gas is discharged into the atmosphere? One other is decay. You all know that in the autumn the leaves fall off the trees, and sometimes accumulate till they are up to your ankles, or even higher. I have not any decaying leaves to experiment with, but I have some rotten wood; and I want to show you that by this, and by the rotting of leaves, sawdust, and bodies generally, we get carbonic gas. Here is a tube in the shape of the letter U, containing some lime-water, and we will suck the air from this tube through the lime-water, and you will see that the rotting wood has the property of giving off this carbonic gas and rendering the lime-water turbid. Decaying leaves and decaying sawdust would do the same.

Another way in which this gas is also discharged into the atmosphere is by breathing. Here we will vary the experiment a little by putting the lime-water into the bottle first. I will shake up the lime-water to show you that there is nothing formed at present; I do not shake it very violently, or it would form a froth which you might mistake for the whitening of the liquid by the formation of chalk. I now breathe into the bottle, and shake up the contents as I did before; and you will observe that the soluble lime is at once converted into chalk.

You see, then, that this gas from chalk or marble is constantly poured into the atmosphere from endless sources—from all burning bodies, from all decaying bodies, and from all breathing animals. Now is there any other source? In various parts of the earth, more particularly in volcanic districts, we find that quantities of this gas issue from the earth with enormous force. Indeed, so great is the quantity, that it is probable that the amount of this fixed air evolved into the atmosphere from fissures in the earth, and from caves, and volcanoes, and sources of that kind, far exceeds that which is discharged into the atmosphere by all the fires, all the decay, and all the breathing animals on the surface of the earth. Now I cannot bring you any of this natural gas bottled up—at least, not very conveniently; but we find that it may be obtained in other ways. The gas which issues from the surface of the earth sometimes comes up in the form of gas; but sometimes we find water saturated with it—and this is the nature of the natural effervescing waters, such as the Seltzer water, which is imported into this country in bottles, and of the Brighton, or artificial Seltzer water, which is made to imitate the natural water. In these waters a large quantity of the gas is condensed, and it is given off from them just as it is evolved from charcoal by burning it. We will put a screw tap into a bottle of Seltzer water, and see whether we can get any carbonic gas evolved. We turn the tap, and collect some of the gas which is given off, and we find that the gas evolved from Seltzer water is identical with the carbonic gas we have been considering. This illustrates one of the many natural sources of this gas.

You will perceive, then, that in consequence of the constant occurrence in nature of the actions which I have mentioned, the air by which we are surrounded must contain carbonic gas, and as a natural consequence, charcoal. The

invisible air by which we are surrounded really contains charcoal in the form of an invisible gas, and you would, perhaps, think that from the existence of so many natural sources of the gas, the proportion of carbonic gas in the air ought to be very large; but in reality it is extremely small—amounting to only half a part in a thousand; in fact, it is rather less than half a part, but I state it broadly that you may remember it. Now, I can give you some illustration of the quantity by means of an experiment. I have here a tube which contains this carbonic gas, and into the tube I put, not lime-water, but milk of lime—a mixture of lime and water, containing more lime than the water can dissolve. We now shake up the tube of gas and then open it under water; we pour in some more of this milk of lime, and we shall be able by repeating this to dissolve the whole of this kind of air, which, you remember, is called fixed air, because lime has the property of fixing it. I close the end of the tube with my thumb, and shake up the lime with the air of the tube, and again open it under water. You see, the water immediately rises to a considerable height in the tube, and if we continue to operate in this way the water will at last rise to the extreme top; this shows that the lime has the property of completely absorbing this gas. Now if we take this other tube, which only contains common air, and treat it in the same way, the quantity of carbonic gas in the ordinary air is so very small that you will not notice any absorption whatever. I close the tube with my thumb, and shake it up as I did the other, and then insert it under the water and open it, and you will observe that there is practically no absorption, or rather the amount of absorption is so small that you cannot notice it. It amounts to only half a part in a thousand.

Nevertheless, I can show you the presence of this gas in the air if I adopt certain means. I will take some lime-water, and introduce it into this tube in front of you. Here is a vessel, termed an aspirator, filled with coloured water; and if I turn the stop-cock, and allow the water to run out, you will observe that, as the water runs out, the air must be sucked through the lime-water to fill its place; and I daresay that by the end of the lecture we shall have drawn through the lime-water a sufficient volume of air to affect it and render it turbid.

The action is here going on in another way. In this dish I have placed some lime-water, which was originally perfectly clear and brilliant. If you look at it after the lecture you will see that it will be covered with a scum of chalk, due to the carbonic gas in the air of the room. In this way we find that carbonic gas, and consequently charcoal, is a constant constituent of atmospheric air.

(To be continued).

NOTE ON

A MERCURY-COMPOUND OF ACETYLENE.

By H. BASSETT.

On passing a stream of coal-gas through the solution known as Nessler's ammonia-test, *i.e.*, a solution of mercuric iodide in iodide of potassium and caustic potash, a considerable quantity of a bright yellow precipitate is obtained. This precipitate is only formed in presence of free potash. After drying, it explodes slightly on heating, giving a sublimate of mercury and iodide of mercury, and leaving a carbonaceous residue. On warming with dilute hydrochloric acid, an inflammable gas is given off, having the characteristic smell of acetylene, and giving, with ammoniacal cuprous chloride, the well-known red precipitate.

The experiment was modified as follows:—A large Bunsen burner was lighted at the bottom, and the supply of air partly cut off; the products of combustion were drawn by an aspirator through a washing-bottle of water, and then through the mercurial solution. This method gave a precipitate of a pale yellowish colour, which exploded rather more violently than the above, resembling in appearance that which was found to be produced by pure acetylene (from the copper compound).

On analysis, this substance gave 70·24 per cent mercury and 23·5 per cent iodine. These numbers may be considered to indicate sufficiently the formula—

$$C_2HHg''I + Hg''O_2,$$

which requires 70·42 and 23·36 respectively.

The different appearance of the precipitate produced by coal-gas appears to be owing to the presence of other hydrocarbons. In fact, crude benzene gave a bright yellow precipitate, as also did purified oil of turpentine. No precipitate was produced by ethylene or pure benzene. In the case of turpentine, the action seems to consist in a reduction of the mercuric salts with formation of mercuroso-mercuric iodide, of which the precipitate is mainly composed, with only a trace of organic matter.

SPECTROSCOPIC OBSERVATIONS OF THE SUN.

No. II.*

By J. N. LOCKYER.

The author, after referring to his ineffectual attempts since 1866 to observe the spectrum of the prominences with an instrument of small dispersive powers, gave an account of the delays which had impeded the construction of a larger one (the funds for which were supplied by the Government-Grant Committee early in 1867), in order that the coincidence in time between his results and those obtained by the Indian observers might not be misinterpreted.

Details are given of the observations made by the new instrument, which was received incomplete on the 16th of October. These observations include the discovery and exact determination of the lines of the prominence spectrum on the 20th of October, and of the fact that the prominences are merely local aggregations of a medium which entirely envelopes the sun. The term chromosphere is suggested for this envelope, in order to distinguish it from the cool absorbing atmosphere on the one hand, and from the white light-giving photosphere on the other. The possibility of variations in the thickness of this envelope is suggested, and the phenomena presented by the star in Corona are referred to.

It is stated that, under proper instrumental and atmospheric conditions, the spectrum of the chromosphere is always visible in every part of the sun's periphery; its

* Abstract from the *Proceedings of the Royal Society*, No. 106, 1868.

height, and the dimensions and shapes of several prominences, observed at different times, are given in the paper. One prominence, 3' high, was observed on the 20th of October.

Two of the lines correspond with Fraunhofer's C and F; another lies 8° or 9° (of Kirchhoff's scale) from D towards E. There is another bright line, which occasionally makes its appearance near C, but slightly less refrangible than that line. It is remarked that the line near D has no corresponding line ordinarily visible in the solar spectrum. The author has been led by his observations to ascribe great variation of brilliancy to the lines. On the 5th of November a prominence was observed in which the action was evidently very intense; and on this occasion the light and colour of the line at F were most vivid. This was not observed all along the line visible in the field of view of the instrument, but only at certain parts of the line which appeared to widen out.

The author points out that the line F invariably expands (that the band of light gets wider and wider) as the sun is approached, and that the C line and the D line do not; and he enlarges upon the importance of this fact, taken in connection with the researches of Plücker, Hittorf, and Frankland on the spectrum of hydrogen—stating at the same time that he is engaged in researches on gaseous spectra which, it is possible, will enable us to determine the temperature and pressure at the surfaces of the chromosphere, and to give a full explanation of the various colours of the prominences which have been observed at different times.

The paper also refers to certain bright regions in the solar spectrum itself.

Evidence is adduced to show that possibly a chromosphere is, under certain conditions, a regular part of star-economy, and the outburst of the star in Corona is especially dwelt upon.

ON THE ACTION OF SUNLIGHT ON BISULPHIDE OF CARBON.

By O. LOEW,
Chemical Assistant in the College of the City of New York.

Pure bisulphide of carbon, when exposed to the sunlight for a considerable time, becomes somewhat yellow. To study the changes thus produced, a large quantity of the bisulphide was enclosed in sealed tubes and exposed to the action of the sun. Decomposition took place gradually, and a brown insoluble substance was formed, which adhered so closely to the inner surface of the tubes that it could not be detached by vigorous shaking. This substance prevented the further action of the sun's rays, and consequently the decomposition ceased.

If water be present in the tubes, this adherence is prevented, and a larger quantity of the brown substance is obtained. After an exposure of two or three months the tubes were opened. The water was slightly acid in its reaction, and, after being neutralised and concentrated, it showed a distinct reducing power upon salts of silver and mercury. Evidently, therefore, a trace of formic acid was produced, according to the following equation:—

Formic Acid.

$$CS_2+2H_2O=CH_2O_2+H_2S+S.^*$$

On filtration, the newly-formed brown compound remained on the filter, while the filtrate contained free sulphur dissolved in the bisulphide of carbon. On examination, this compound corresponded in every particular to the sesquisulphide of carbon, the substance discovered by me two years ago. It was insoluble in water, alcohol, ether, chloroform, bisulphide of carbon, and oils, but soluble with decomposition in a boiling solution of caustic potash. On heating it in a glass tube, it was directly separated into its components; the sulphur volatilised and the carbon remained.

If sulphocarbonate of potash in concentrated solution be exposed to the sunlight, the decomposition is so slight as hardly to be noticed; when the solution is treated with sodium amalgam, however, a reduction to lower sulphides takes place.

In view of the fact that direct sunlight reduces free bisulphide of carbon, it might be supposed that the corresponding body, carbonic acid, would, in presence of water, be reduced in a similar manner; all my experiments in this direction, however, have thus far been unsuccessful. Nevertheless, since this reduction takes place very readily in the tissues of plants under the influence of sunlight, I am not without hope that this process will yet be imitated in the laboratory.—*American Journal of Science*, November, 1868.

* C = 12; O = 16; S = 32, &c.

ON THE ALLEGED POISONOUS QUALITY OF BEEF-TEA AND EXTRACT OF MEAT.

By BARON LIEBIG.

Although it is contrary to common sense to believe that the daily food of men and animals could possibly contain a substance injurious to health, it was nevertheless to be expected that the experiments made by Dr. Kemmerich on the effect of beef-tea and its salts on animals would produce anxiety and fear in some weak minds; and, indeed, the article which appeared in *Once a Week*, entitled, "A Word of Warning to Cooks," is a proof that such fears really existed. I believe, however, that a simple acquaintance with the experiments of Dr. Kemmerich will be sufficient to dispel them completely. The results of these experiments are of a very harmless character. Dr. Kemmerich made most of his experiments, not upon men, but upon graminivorous animals, viz., upon rabbits, and only one experiment was made by him upon a dog. The broth was made from horseflesh, and injected into the stomach of the animals in progressively augmented quantities, the chief results of which are as follows:—

A rabbit weighing not quite two pounds, which had received the broth from one pound of horseflesh (equivalent to half an ounce of extract), remained perfectly well. It polished itself with its paws, was very lively, and no disturbance in the state of its health was afterwards perceptible.

A second rabbit of two pounds weight, into the stomach of which the extract of one pound and a quarter of horseflesh had been introduced, deported itself in just the same manner; its pulse became more vigorous, its breathing slower, and it remained lively and healthy.

When, however, the doses were increased, and the extract of two pounds and of two pounds and a quarter of flesh were injected into the stomach of the rabbit, such quantities of concentrated animal food were evidently too much for the little graminivorous creature, which by such doses Dr. Kemmerich succeeded in killing, a result at which nobody will be surprised. It follows that Dr. Kemmerich could likewise have killed stronger animals with beef-tea; and it may be assumed that he would have killed even a man of 140 lbs. weight (seventy times heavier than a rabbit) by a dose of beef-tea seventy times as large,—namely, by the broth of 140 lbs. of flesh, equivalent to about 4 lbs. of extract of meat. Less than a couple of pounds of extract would, however, scarcely have been sufficient, for one of the experiments of Dr. Kemmerich on a carnivorous animal contrasted with the experiments on the rabbits; he did not succeed in poisoning that animal with beef-tea.

It was a small but very strong terrier which had taken the broth of four pounds of flesh (equivalent to two ounces of extract), which the animal seemed to enjoy considerably. As, however, the whole quantity was too much for it, it became necessary to inject the remainder into its stomach. Notwithstanding the enormous quantity of extract of meat which had been introduced by force, the terrier remained very comfortable and lively, and no symptom of any disturbance of its health became manifest. Double the of meat-broth which killed the rabbit had not the least injurious effect on the little dog.

These experiments and the above calculations show sufficiently what is to be thought of the poisonous effect of beef-tea; it belongs to the category of cases where people have eaten *pâté de foie gras*, turtle soup, or oysters to such excess as to cause death; but no sensible person will ever dream of ascribing, on that ground, poisonous qualities to *pâté de foie gras*, turtle soup, or oysters.

The experiments of Dr. Kemmerich are described in his "Dissertatio Inauguralis," for obtaining the degree of Doctor from the medical faculty at Bonn; and in his connecting with his conclusions the meaning of the word "poison" he, in fact, succeeded in drawing to his work the attention of the public, which otherwise would probably have taken little notice of it.

Dr. Kemmerich ascribes the effect of beef-tea not to its aromatic and combustible ingredients, but to the potash salts which it contains, and of which it is well known that in larger doses they exercise an injurious effect on the organism; nevertheless, and this is a matter of great importance, potash salts are an element of all articles of food; they not only form the chief ingredients of the salts of all sorts of flesh, including the flesh of fish, but likewise of all other food, and of all the food of animals. The alkaline salts of bread, vegetables, and hay consist of potash salts, and, with the exception of chloride of sodium (kitchen salt), soda salts are but rarely contained therein; in fact, it may safely be asserted that without the potash salts our food would be quite unfit for nourishment.

It does not follow, therefore, that these salts, when taken in excess, like any other—even the most harmless substance—might not eventually exercise an injurious effect. It is however, preposterous to apply the meaning which we are accustomed to attach to the word "poison" to the effects of such an excess. It is surely quite absurd to connect this meaning with substances which we daily take in our food, and which are quite indispensable to our existence.

Dr. Kemmerich himself says (p. 31), "I do not think of the possibility that beef-tea, in the form in which it is used for household purposes, could be the cause of poisoning; it therefore does not require a medical warning to protect from poisoning with Liebig's extract of meat." He further says, "In medical practice, wine, ether, camphor and musk are eminent analeptica (invigorating and refreshing remedies). Compared to these giants of medicine beef-tea modestly occupies a subordinate position. If however, it be necessary to preserve the exhausted body from protracted illness, then there is no other remedy in the whole rich store of medicine which can afford such assistance for regenerating the diseased organism as repeated doses of beef-tea."

One of the three theses defended by Dr. Kemmerich, on his promotion before the medical faculty at Bonn, is worthy of observation by the British navy. It runs thus:—

Thesis 2. "The best remedy against scurvy is beef-tea, or Liebig's extract of meat."—*Pharmaceutical Journal.*

Preparation of Nitrogen.—A new and elegant method of preparing nitrogen gas has been devised by an Italian chemist, M. Massino Levy. It consists in heating bichromate of ammonia in a retort. The salt is transformed into green sesquioxide of chromium, and disengages vapour of water and nitrogen.—*Cosmos.*

ON FOOD.*

By DR. LETHEBY, M.A.. M.B., &c.

(Continued from vol. xviii., p. 281.)

Preservation of Food—Unwholesome and Adulterated Food.

I COME now to the last division of our subject—viz., that which relates to the sale and use of unsound and adulterated food; and perhaps the most important of this kind of food is bad meat—that is, meat which is unwholesome on account of putridity or disease. Food of this description has always been a subject of legal prohibition. Among the Jews the prohibition dates from the time of Moses, who is supposed to have received from the Lord, during his sojourn upon Mount Sinai, certain oral commandments respecting the slaughtering of animals for food and the examination of their bodies for disease. There is no account of these commandments in the written law, but they were evidently communicated to the people of Israel by Moses, for he says, "Thou shalt kill of thy herd, and of thy flock, which the Lord hath given thee, as I have commanded thee."—(Deut., chap. xii., v. 21.) It is presumed, therefore, that these instructions were very specific, and they have been practised by the Jews from that time until now. The Hebrew law is, that no flesh shall be eaten, except of animals that have been killed and searched, or examined, by the officer (*bodek*) appointed for that purpose; and the most precise rules are laid down for his guidance in these matters. In fact he is bound by very solemn obligations to declare of every animal that he kills whether the flesh is proper to be eaten (*caser*), or is unfit for food, by reason of its being diseased or torn (*trefa*). This expression appears to have been derived from an ordinance of Moses, that no flesh should be eaten that is torn in the field (Exodus, chap. xxii., v. 31); the word torn (*trefa* or *terefa*) being supposed, according to the traditions of Hebrew sages, to apply not only to animals torn in the chase, or by wild beasts, or by the bungling act of the butcher, but also to those affected with any disease that would shorten their lives; and as it is thought that such disease is always indicated by the condition of the lungs, the utmost care is taken by the searcher or bodek in the examination of these organs. His rules or instructions for this purpose are very strict; but generally it may be said that he condemns as unlawful, or unfit for food, the flesh of all animals in which the lungs present the following appearances:—Certain deficiences, excess, or displacement of the lobes; adhesions, or false membranes; tubercles, or abscesses containing matter or opaque water; discolourations which do not disappear when the lungs are inflated; ulcers, holes, and abrasions letting air through them; consolidations that are impervious to air, and rottenness of tissue. Many of these are, no doubt, unimportant evidences of disease, and, therefore, although the flesh of such animals is rejected by the Jew, it is freely consumed by the Christian. The Jews, indeed, make a sort of bargain with the unorthodox butcher, to take only such animals, when slaughtered by their officer, the bodek, as he considers lawful, and the rest are sold to the public. I dare say this has been the practice at all times, for there are frequent references to it in our legal and domestic records. In *Liber albus*, for example, there is a memorandum to the effect that on the 24th of June, 1274, certain discreet men of the city were summoned before the king's council, to answer the question as to what was done with the unclean flesh of the Jews, and whether it was lawful for Christians to buy and eat the same. Their answer was, that if any citizen bought such flesh of a Jew, he would be expelled, and if convicted by the sheriff he would forfeit

* The Cantor Lectures, delivered before the Society of Arts.

such flesh, which would be given to lepers or dogs, and he, in addition, would be heavily fined. To which the council replied that they commanded them, in the king's name, to have the custom strictly observed. I fear, however, from the legal records of *Liber albus*, that less attention was paid in those days to the sale of diseased meat than to that of putrid meat; for, on examining the accounts of the citizens made and rendered in divers courts of the king, I find that while "judgment of pillory" is recorded in twenty-one cases for selling putrid meat, poultry, or fish, there is not a single instance of a like punishment for selling the unclean meat of the Jews.

In ancient Rome there were overseers appointed to examine the meat in the public markets before it was sold, and butchers were often fined for neglecting the law in this respect. Mr. Charles Reed has given us an example of this from the *Acta Diurna*, or Roman Gazette, of 585 years after the building of Rome, which, when translated, runs thus: A.U.C. DLXXXV., Fourth of the kalends of April. The fasces, with Licinius, the consul, and Lertinus, ædile, fined the butchers for selling meat which had not been inspected by the overseers of the markets. The fine is to be employed towards building a chapel to the temple of the goddess Tellus.

In modern times, also, severe regulations have been made in all the states of Europe for the government of this matter, and in many cases particular instructions are given as to the kind of disease which renders meat unfit for human food—it being the practice to examine the animal while alive, and its carcass when dead. This examination is entrusted to properly-qualified officers, who are bound to condemn diseased and putrid meat, as well as the flesh of animals that have died otherwise than by the hand of the butcher, and no meat can be sold until it has undergone such an examination. In this country, however, although there are laws prohibiting the sale of unsound and unwholesome food, yet there is no provision for the systematic inspection of meat, even when it has reached the public shambles. All that the law declares is that the local authority may, if it pleases, appoint an officer for that purpose; and as the appointment would cost money, and is not compulsory, it is rarely made. Practically, therefore, there is, except in a few places, an almost unchecked traffic in diseased and unwholesome meat, and the worst descriptions of it are generally sold to the poor at night.

Our forefathers made stringent rules to prevent this; for, among other things, they ordained "that butchers shall close their shops before candle-light, and shall not sell flesh meat by light of candle."—(*Liber albus.*)

Within the City of London the inspection is performed as carefully as it can be, but, nevertheless, amidst the confusion of business in the early hours of morning, a great deal of unsound meat escapes the notice of the inspectors. In fact, if it were not for the assistance afforded to them by the salesmen of the markets, it would be absolutely impossible to check, to any large extent, the sale of unwholesome meat; for in the three markets of the city—Newgate, Aldgate, and Leadenhall, as much as 400 tons of meat are sold daily. It is brought from all parts of Great Britain and Ireland, as well as from Belgium, Holland, and France, and even from the ports of the Baltic. Of this a large quantity is diseased, and it comes chiefly from our own country towns, where it is a common practice to forward to London everything that is unsaleable at home. I cannot tell what is the actual proportion of bad meat to good, but we seize and condemn about two tons a week, and this is in the proportion of one part to 750. Last year the amount of meat condemned as unfit for food was nearly 129 tons, and in the preceding year it was more than 152 tons. In fact, during the seven years which have expired since the inspectors were appointed under my recommendation, we have seized and destroyed 1,567,810 lbs., or just 700 tons of meat as unfit for human food. Of this quantity, 805,653 lbs. were diseased, 568,375 lbs. were putrid, and 193,782 lbs. were from animals that had not been slaughtered, but had died from accident or disease. It consisted of 6,640 sheep and lambs, 1,025 calves, 2,896 pigs, 9,104 quarters of beef, and 21,976 joints of meat; besides which there were also seized and condemned in the city markets, on account of putridity, 19,040 head of game and poultry, 207 quarters of venison, and above 7,000,000 of fish, together with thousands of bushels of whelks, shrimps, periwinkles, &c.

It is to be regretted that in the various Acts of Parliament which relate to the condemnation of unsound meat, there are no special rules for the guidance of the officers appointed to investigate this matter—there being only a very loosely-worded general provision to the effect that the medical officer of health, or the inspector of slaughter-houses, or the inspector of nuisances, may, at all reasonable times, inspect and examine any animal, carcass, meat, poultry, game, flesh, fish, &c., exposed for sale, or deposited in any place for the purpose of sale, or in preparation for sale, or intended for the food of man; and in case it appears to the medical officer of health, or the inspector, to be diseased, or unsound, or unwholesome, or unfit for the food of man, it shall be lawful for him to seize the same, and for a justice to order it to be destroyed. In this regulation there is no particular reference to the kind of food which is unwholesome, or to the circumstances which render it so, and therefore much is left to the discretion of the officer who examines it. In the city of London the practice is to condemn the flesh of animals infected with certain parasites, as measles, flukes, &c.; and of animals suffering from fever or acute inflammatory affections, as rinderpest, pleuro-pneumonia, and the fever of parturition, and of animals emaciated by lingering disease, and those which have died from accident or from natural causes, as well as all meat tainted with physic, or in a high state of putrefaction. A little practice is required to distinguish meat of this description, but generally it may be said that good meat has the following characters:—

1st. It is neither of a pale pink colour nor of a deep purple tint, for the former is a sign of disease, and the latter indicates that the animal has not been slaughtered, but has died with the blood in it, or has suffered from acute fever.

2nd. It has a marbled appearance from the ramifications of little veins of fat among the muscles.

3rd. It should be firm and elastic to the touch, and should scarcely moisten the fingers—bad meat being wet, and sodden, and flabby, with the fat looking like jelly or wet parchment.

4th. It should have little or no odour, and the odour should not be disagreeable, for diseased meat has a sickly cadaverous smell, and sometimes a smell of physic. This is very discoverable when the meat is chopped up and drenched with warm water.

5th. It should not shrink or waste much in cooking.

6th. It should not run to water or become very wet on standing for a day or so, but should, on the contrary, dry upon the surface.

7th. When dried at a temperature of 212° or thereabout, it should not lose more than from 70 to 74 per cent of its weight, whereas bad meat will often lose as much as 80 per cent.

Other properties of a more refined character will also serve for the recognition of bad meat, as that the juice of the flesh is alkaline or neutral to test-paper, instead of being distinctly acid; and the muscular fibre, when examined under the microscope, is found to be sodden and ill-defined.

The signs of parasitic diseases are not always observable without careful examination. In the case of the fluke in the livers of sheep, and of measles in pork, and of hydatids in the brain or liver, the nature of the disease is at once

discoverable, but it is not so with the smaller measles or *cysticerci* of beef and veal, and it is still less so with the *trichina* of pork—the microscope being required to reveal their presence.

And here, perhaps, we may ask, what are the effects of diseased or putrid meat on the human system? The question is undoubtedly very difficult to answer, for while, on the one hand, we have abundant evidence that such meat may frequently be eaten with impunity, so on the other we have many remarkable instances of injury occasioned by it. In Scotland there is a disease called braxy, which attacks the sheep and lambs in spring and early summer. It is the cause of at least half the deaths in the flock during the year. The disease kills the animals very quickly by causing stagnation of blood in the most important vital organs; and as the carcase is the perquisite of the herdsman, he most invariably eats it—taking the precaution to remove the offal, and to cut away the darker portions of the flesh where the blood has stagnated. He also salts it before he uses it; and if questioned on the subject he will tell you that the meat is not unwholesome. Every now and then, however, when perhaps the diseased parts have not been entirely removed, or when the salting has not been sufficiently prolonged, or the cooking has not been thoroughly effected, the most serious consequences result from it, insomuch that many medical practitioners who are acquainted with the habits of the Scotch shepherds in this respect, and have seen the mischief occasioned by the meat, declare that braxy mutton is a highly dangerous food for man. Again, it is a common practice with farm-labourers to eat the flesh of sheep affected with staggers, which is a parasitic disease of the brain; and even of animals dying from acute inflammatory diseases. There is a story told on the authority of Dr. Brücke, the professor of physiology in Vienna, that some years ago, when the steppe-murrain was prevalent in Bohemia, and the infected animals were killed and buried by order of the government, the poor people dug up the carcases of the dead bullocks, and cooked them, and ate them without injury. In this country also, during the prevalence of rinderpest in 1863, enormous quantities of meat from the diseased animals were sent to market, and sold and eaten. The same has been the case with the carcases of animals suffering acute pleuro-pneumonia; and if, as Professor Gamgee says, the practice of making salvage out of diseased animals in so common that at least one-fifth of the meat which is sold in the public markets is diseased, we may well ask, in the words of Mr. Simon, how it is that some sort of pestilence is not bearing witness to the fact? How is it that cattle having all the foulness of fever in their blood, or having local sores and infiltrations, that yield one of the deadliest of inoculable morbid poisons, or having their flesh thronged with larval parasites, do not, when slaughtered and eaten, produce a general poisoning? Parent Du Chatelet has commented in very forcible language on the apparent immunity from disease even when the most foul and loathsome of animal foods are eaten. But is it not possible that the danger is averted by the operation of cooking? Not that the human stomach has not also a wonderful protective power in its own natural functions; for the deadly poison of the cobra or the rattle-snake may be swallowed with impunity. It is possible, however, that these safeguards may fail us occasionally, and then it is perhaps that the most serious consequences arise. I have often had to investigate cases of mysterious disease which had undoubtedly been caused by unsound meat. One of these, of more than ordinary interest, occurred in the month of November, 1860. The history of it is this:—A fore-quarter of cow-beef was purchased in Newgate market by a sausage-maker who lived at Kingsland, and who immediately converted it into sausage meat. Sixty-six persons were known to have eaten of that meat, and sixty-four of them were attacked with sickness, diarrhœa, and great prostration of vital powers. One of them died; and at the request of the coroner, I made a searching inquiry into the matter, and I ascertained that the meat was diseased, and that it, and it alone, had been the cause of all the mischief. Dr. Livingstone tells us that when the flesh of animals affected with pleuro-pneumonia is eaten in South Africa, by either natives or Europeans, it invariably produces malignant carbuncle. He says, indeed, that the effects of the poison were often experienced by the missionaries who had eaten the meat, even when the presence of the disease was scarcely perceptible; and in many cases when the Backwains persisted in devouring the flesh of such diseased animals, death was the consequence. The virus, he says, is neither destroyed by boiling nor by roasting, and of this fact he had innumerable instances. Now, it is a remarkable circumstance that ever since the importation of this disease (pleuro-pneumonia) into England from Holland in 1842, the annual number of deaths from carbuncle, phlegmon, and boils, has been gradually increasing. In the five years preceding that time the mortality in England from carbuncle was scarcely 1 in 10,000 of the deaths; from 1842 to 1846 there is no record of the disease; but in the next five years, from 1846 to 1851, the mortality rose to 2·6 per 10,000 of the deaths; and in the next five years it amounted to 6·2 per 10,000; and in the succeeding five years to 5·4. In the case of phlegmons, the increase in the mortality is still more remarkable, for it rose from an average of 2·5 per 10,000 of the deaths in the five years preceding the importation of the disease, to 81 per 10,000 in the ten years from 1847 to 1856. The Registrar-General of Scotland has directed public attention to this fact, saying that deaths from carbuncle are on the increase, and that the mortality from it has been getting larger and larger ever since the lung disease of cattle was imported into Scotland. This accords with the experience of medical practice; but as it is very difficult to trace the immediate connection of bad food with subsequent disease, there being so many circumstances to weaken the connection, it is not surprising that differences of opinion should exist as to the morbific effects of unsound meat; nothing, in short, but an experimental inquiry into the subject, as has already been done in Germany in the case of parasitic diseases, will bring the question to rest; and I see no reason why such an investigation should not be made on the persons of those who send diseased meat to the public market for sale; for as the common defence of their conduct is, that the meat is good for food, they cannot surely object to the penalty of being made to eat it. Here, for example, is a specimen of pork covered with pustules of small-pox; it was seized by one of the city officers on the road to a notorious sausage-maker, and it may, notwithstanding its disgusting appearance, be good and wholesome food; then why not put the question to the proof by making the vendor of it eat it? In the year 1862, when small-pox was prevalent among the sheep in several parts of England, it was a common practice to send the carcases of diseased animals to the London markets for sale as human food. Later still, in 1863, there was an epidemic of what seemed to be scarlet fever among the pigs of this metropolis, and their carcases, with all the bright crimson look of the disease, were invariably sent to market for salt as food. Since then the London pigs have been the subject of a virulent spotted fever, of the nature of typhus, and these also have been killed in the last stage of the disease, and sold for food. Abundant illustrations of this kind are constantly coming under my notice, and I feel that the question of the fitness of such meat for food is in such an unsettled state that my action in the matter is often very uncertain, and I should like to have the question experimentally determined; for, as it now stands, we are either condemning large quantities of meat which may be eaten with safety, and are, therefore, confiscating property, and lessening the supply of food, or we are permitting unwholesome meat to pass almost unchallenged in the public markets.

(To be continued).

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 15th, 1868.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

"*Researches on Di-Methyl*," Part II., by WILLIAM H. DARLING, Dalton Scholar in the Laboratory of Owen's College. Communicated by Prof. H. E. Roscoe, Ph.D., F.R.S.

In a communication made to the Society in April last I showed that ethyl chloride was obtained by treating with chlorine the gas di-methyl obtained by electrolysis, and that from this substance ethyl alcohol was prepared.

In continuation of that paper I beg to lay before the Society the results of the examination of the properties of the di-methyl obtained by two other processes; first by that of Schützenberger, and finally by that proposed by Frankland.

The former process consists in treating acetic anhydride with peroxide of barium, when the two gases di-methyl and carbonic acid are said to be given off; in the latter process the action of zinc on methyl iodide in sealed tubes heated to about 150° C. yields di-methyl.

These two methods were tried for the preparation of di-methyl, but were abandoned for the electrolysis method for reasons which will be noticed further on.

1. *Preparation of Di-Methyl by Schützenberger's Process.*—When peroxide of barium acts on acetic anhydride, a gas stated to be di-methyl is given off.

If the peroxide is heated with the anhydride, as Schützenberger directs, violent explosions occur. This can be avoided by mixing the peroxide with dry sand, provided the flask containing the mixture is not cooled; if it is cooled, the reaction after a time becomes so violent, probably owing to the formation of peroxide of acetyl, that explosions occur.

20 grms. of peroxide of barium mixed with 40 grms. of dry sand were poured into a flask containing 20 grms. of acetic anhydride and mixed by shaking; the gas evolved was collected in a Pepy's gas holder, and afterwards displaced by pressure, purified by passing through a solution of caustic potash and afterwards through concentrated sulphuric acid. The treatment with chlorine, exposure to the sun's light, and final displacement, was effected in the method described in the previous paper.

The total volume of liquid obtained from acetic anhydride prepared from one pound of phosphorus did not exceed 25 c.c., and began to boil at 40° C., the temperature rising up to 80° C. This quantity proved too small to admit of being fractionated, in order to separate any more highly chlorinated products.

In order to ascertain the cause of so small a yield of chloride, the gas was analysed, according to Bunsen's method, and proved to be a mixture of carbonic oxide, marsh gas, di-methyl, with a small amount of olefines, the following being the result :—

Carbonic oxide	4.29
Olefines	0·63
C_2H_6..	18·57
CH_4	76·51
	100·00

This analysis clearly shows that Schützenberger's description of the decomposition is incorrect, the greater part of the gas consisting of hydride of methyl or marsh gas.

2. *Preparation of Di-methyl by Frankland's Method.*—Schützenberger's method not giving the required gas, this process was tried. I took advantage of the directions given by Schöyen for the preparation of pure di-ethyl.

Into stout glass tubes closed at one end, metallic zinc, made rough on its surface, was introduced; the open end was then softened before the blowpipe, thickened, and drawn out into a strong capillary, which was bent twice at right angles, as described by Frankland. Through this the methyl iodide was introduced, and afterwards the ether, equal in volume to that of the iodide. The air was expelled by boiling the ether and closing the capillary.

Tubes thus prepared were heated to 130° C., until all the zinc was dissolved, then opened before the blowpipe when cold, to allow any marsh gas to escape which had been formed by the presence of moisture, again closed and heated to 150° C. for several hours. The tubes when cold were then immersed in a mixture of salt and ice: the end of a narrow tube of thick caoutchouc drawn over the capillary, the other end being attached to a gas-holder containing a saturated solution of common salt, and the end of the capillary was then broken off. The gas rushed into the holder, the internal pressure frequently projecting some of the liquid contents of the tube into the gas-holder, where in contact with the water, decomposition took place with the formation of marsh gas, it being impossible to decompose all the zinc-methyl.

The di-methyl thus obtained on treatment with chlorine &c., yielded a small quantity of a liquid which began to boil at 11° C., and rose above 80° C. The quantity was however, but small, in consequence, no doubt, of the presence of marsh gas derived from the zinc-methyl, which was carried over by the pressure of the gas in the tubes; and as it became apparent that considerable difficulty would be encountered in preparing large quantities of the pure gas by this method, it was abandoned.

An analysis of this gas, according to Bunsen's method, shows that pure di-methyl is to be obtained by this method—

	Found.	Calculated for Di-methyl.
Gas employed	16·71	
Contraction	42·30	41·77
Carbonate acid	33·50	33·42

I cannot conclude this communication without expressing my thanks to Professor Roscoe and Mr. Schorlemmer for the very able assistance rendered to me throughout this research.

"*On a Property of the Electric Current to Control and Render Synchronous the Rotations of the Armatures of a number of Electro-Magnetic Induction Machines*;" Illustrated by Working Models; by Henry Wilde, Esq.

FOREIGN SCIENCE.

PARIS, Jan. 13, 1869.

Reagent for Alkaloids.—Purification of Bisulphide of Carbon.—Detection of Strychnine.—Crystallisation of Glycerine.—Detection of Mercury in Poisoning Cases. ACADEMY OF SCIENCES: Native Arseniate of Zinc.—Election of M. Jamin.

THE double iodide of cadmium and potassium has been proposed as a reagent for alkaloids by M. Marmé.

This compound precipitates the following alkaloids from very dilute solutions mixed with sulphuric acid:—Nicotine, conicine, piperine, morphia, codeia, thebaine, narcotine, narceine, quinine, quinidine, cinchonine, strychnine, brucine, veratrine, berberine, atropine, aconitine, and some others. The precipitates are white and flocculent, but for the most part become crystalline. Quinine and strychnine, diluted with 10,000 parts of water, are entirely precipitated. These precipitates are insoluble in ether, soluble in alcohol, slightly soluble in water, and soluble in an excess of the double iodide. By agitation with a

suitable solvent and the subsequent addition of alkali, the alkaloids may be separated. The double iodide of cadmium and potassium does not precipitate glycosides (amygdaline, salicine, saponine, digitaline, phloridzine, &c.).

M. Millon publishes a note "On the Purification of Bisulphide of Carbon." The sulphide of carbon is first washed several times with distilled water, as in the purification of ether, and then transferred to a retort of large capacity containing quick lime. After twenty-four hours' contact the sulphide is distilled off from the lime and received in a flask partially filled with copper turnings, previously roasted to remove all traces of fatty matter, and afterwards reduced by hydrogen. The lime remaining in the retort is strongly coloured. All the disagreeable odour of ordinary bisulphide of carbon is removed by this treatment, and when the nose is placed close to the mouth of the receiver an ethereal odour is only perceived. With bisulphide of carbon thus purified MM. Millon and Commaille have separated the perfume of the most delicate flowers, and even the perfume of milk to the extent of recognising certain plants eaten by the cow, the *Smyrnium olusatrum* among others.

To detect the presence of strychnine in cases of poisoning, M. Cloetta counsels the following treatment:—Any albumen which may be present in the liquid is first removed, sub-acetate of lead added, and the liquid filtered; the excess of lead is removed by sulphuretted hydrogen, another filtration made, and the filtrate evaporated to dryness. The residue thus obtained is left in contact with ammonia for twenty-four hours, then agitated with double its volume of chloroform, and the chloroformic solution evaporated; this residue is dissolved in 2 c.c. of water containing pure nitric acid, the solution filtered, and to the filtrate a drop of solution of bichromate of potash added. At the end of a few days crystals of chromate of strychnine appear, in which the chemical characters of strychnine may be recognised. M. Cloetta affirms that, by his process, he has been enabled to prove the presence of 1-20th grain of strychnine in 650 c.c. of urine.

M. Werner has made some experiments on the crystallisation of glycerine. He was not able to form crystals by agitation or by cold. As he had recognised the presence of chlorine in some solidified glycerine, he made the experiment of passing a few bubbles of chlorine through glycerine of commerce, and, under these circumstances, small octahedral crystals were obtained possessing great hardness, but deprived of the sweet taste of glycerine even when melted.

The following is a method of examination for detecting mercury in poisoning cases, described by M. Buchner. This method was employed by M. Buchner in searching for mercury in the remains of a person poisoned by corrosive sublimate. The organic remains having been disintegrated by a hot mixture of chlorate of potash and hydrochloric acid, the solution was diluted and saturated with sulphuretted hydrogen. After the lapse of some hours the sulphide formed was collected, dissolved in aqua regia, and reduced by evaporation to a small volume. A little water being added, a bright piece of copper wire is placed in the liquid, and when mercury is present, the wire becomes grey, at the latest, in two days. The copper is withdrawn, dried between folds of blotting paper, and heated in a wide test tube. The mercury is more easily distinguished by removing the wire, and placing in the tube a drop of tincture of iodine. M. Riederer, having remarked that the sulphide of mercury which is formed by this process always contains organic matter, has recourse to dialysis. He operates in the following manner:—After disorganisation by chlorate of potash and hydrochloric acid, the mercury in solution is precipitated by sulphuretted hydrogen, the sulphide collected dissolved in a mixture of chlorate of potash and hydrochloric acid, and dialysed with 500 c.c. of water; at the end of five days the water is evaporated and the dialysis repeated. After this treatment, the solution is again saturated with sulphuretted hydrogen; the precipitate is washed with ammonia and sulphide of ammonium, then with weak nitric acid, and finally treated afresh with hydrochloric acid and chlorate of potash. Operating upon dogs with calomel, M. Riederer has recognised that the greater part of the mercurial compound is eliminated by the excrements, and that for the rest, more collects in the liver than in the muscles.

On the 7th of December the following memoirs were communicated:—"The Mechanical Equivalent of Heat Explained by the aid of Æther, tending consequently to confirm the Existence of this Fluid, universally diffused," by M. Burdin; "Researches on Alloys," by M. Riche; "On a Natural Arseniate of Zinc occurring at Cape Garonne," by M. Damour; "Union of Free Nitrogen with Acetylene; Direct Synthesis of Hydrocyanic Acid," by M. Berthelot. M. Jenzsch addressed a complement to his note of the 21st September, "On the Fossils from Rocks, termed Eruptive." The physical section has presented the following list of candidates for the vacant place created by M. Pouillet's decease:—(1), M. Jamin; (2), MM. Bertin, Desains, Favre, Janssen, Le Roux, Lissajous, and Guet.

In a notice inserted in the *Comptes Rendus*, M. Friedel has made known the characters and composition of a new mineral found at Chanarcillo in Chili, to which he has given the name *adamine*. This mineral is formed essentially of oxide of zinc, arsenic acid, and water, and up to the present day is only found in very few collections; it has lately been found in France by MM. Gory and de Boutiny, in the refuse of a copper mine at Cape Garonne (Var). By a qualitative examination, M. Gory has recognised in this mineral the presence of arsenic, zinc, and cobalt. At his request, M. Damour made a more complete examination of this mineral. The adamine of the Cape Garonne occurs in small crystals, in a quartz rock; these crystals are usually lenticular, grouped and joined so as to offer some resemblance to a number of grains of wheat. Nearly all are tarnished, sometimes they are covered with small needles of arseniate of copper (olivenite). Their colour is generally grey, slightly rose-tinted; the hardness is a little greater than that of carbonate of lime. The density at + 15° C. is 4·352; M. Friedel found 4·338 for the samples obtained in Chili. The following are the chemical characters:—Heated in a tube, adamine evolves a small quantity of neutral water, and takes a faint bluish tint; on charcoal before the blowpipe flame, the mineral fuses into a blackish scoria, disengaging white fumes and an arsenical odour. After cooling, a white ring, tinted blue at the border, is observed to encircle the scoria. With borax or microcosmic salt, the blue colour characteristic of cobalt is obtained. Hydrochloric, nitric, and sulphuric acids dissolve the mineral completely.

On the 14th December, M. Filhol presented a memoir "On the Action of Iodine on the Metallic Sulphides." MM. Troost and Hautefeuille communicated a memoir "On some Properties of Cyanic Acid," and M. Schlœsing a memoir "On the Estimation of Phosphoric Acid in Plants." At this meeting M. Jamin was elected to the vacant place in the physical section.

At the meeting on the 21st, the following memoirs were communicated:—Memoir "On the Phenomena of Static Electricity which Accompany the Rapid Destruction of the Adherence of Different Bodies," by M. Joulin; "Action of Ammonia on Phosphorus," by M. Blondlot; "On the Formation and Decomposition of Sulphides of Carbon," by M. Berthelot; "Action of Organic Acids on the Nitriles of the Fatty Acid Series," by M. Gautier; "Remarks on the Sulphide of Allyl, by M. de Clermont; "On a New Formation of Octylic Alcohol, by M. Silva; "On the Bromide of Allyl," by M. Tollens. A note by M. Ferriere, "On the Combustion of Phosphuretted Hydrogen," completes the list. Some account of these researches will appear in a future letter.

NOTICES OF BOOKS.

Chemistry for Students. By A. W. Williamson, F.R.S., F.C.S. Clarendon Press, 1868. New edition.

The well-known text-book of Professor Williamson has reached its second edition in a short space of time, and this will show the general appreciation of it by students. The length of our notice of the first edition will render unnecessary many remarks on its nature, &c., that otherwise would be only just; but we may mention that its characteristics remain,—viz., a strictly chemico-philosophical way of looking at various subjects, with terseness and an almost universal omission of minute detail.

This has never been complained of, for Dr. Williamson from the first has expressed his opinion that books of detail should only be studied when important leading facts, that must always be retained for ready use, are first conquered. Miller's "Elements" and Watts's "Dictionary" are recommended as English handbooks to the student by our author.

Early students thus have this book prepared for them; it is not meant for school use; but the ideas expounded in these pages are essential to all for the due appreciation of organic chemistry, the latest of its results especially.

To the substance of the work no addition of great importance has been made; the number of sections remain as before; the book is essentially the old book corrected and slightly improved. The appearance of it is much neater, the paper now used being toned, and the sharpness and clearness of its printing would entitle it to a place on the drawing-room table rather than the coat pocket of the student. Two entirely new features are the addition of foot notes explanatory of subject matter, and squares for the amplification of the author's suggestion of the use of an absolute volume. The former mostly consist of equations showing the symbolical formulæ of the process described; in them are also given molecular and volumetric expressions, in addition to those of equivalence before existing in the work. The squares aroused our curiosity; we wanted to know if Professor Williamson, like Dr. Miller (who, indeed, has always patronised volume-squares), would express the square of phosphorus as half the size of the hydrogen or oxygen square, but unfortunately, this symbolic method is not carried on in the work further than the gaseous compounds of sulphur. In addition to these improvements, tables, absolute and comparative, are given of the leading salts of the elements, and the well-known consistency of Dr. Williamson's nomenclature is even more rigidly than ever enforced in the case of organic hydrogen salts. We will not say that answers are given to the problems,—far better, the problems are fully worked out; and this addition is of special value.

A very unpretending improvement will be really found most valuable to the student. We allude to the table of contents, which has been enlarged to nearly twice its size—for of all things a deficiency in this respect for rapid reference is most annoying. This improvement, we venture to say, is second to none made upon the former edition. The old edition further contained a page of matter now, we are delighted to see, omitted—we allude to the page of corrections; the misprints also, not mentioned in that table have been rectified, and we no longer find TO_4H_2 representing sulphuric acid.

The accuracy of the supervision of the text is shown in the new table of the elements, in order of their equivalency; the atomic weight of vanadium is halved and placed in the triad group, but the place claimed for it by Roscoe, in the nitrogen family, between phosphorus and arsenic, is not allowed. It will be interesting to theorists to learn that ruthenium, rhodium, and iridium are retained by our author in the group of even equivalence, and are not considered trivalent.

This group of even equivalence comprises, we are glad to see, dyads and tetrads; the hexads of Miller, Odling, Nacquet, &c., are also retained in this group, and pentads as such, as far as elements are concerned, are not recognised; neither erbium nor terbium ranks as an element. In our opinion, this philosophic caution deserves both a wide and an early imitation.

In conclusion, we may express a hope that the new edition may run as successful a career as the old, and that the next may be still further improved, and, we hope, extended, by the introduction of the author's classification of elements by their chemical reactions.

CORRESPONDENCE.

OZONE.

To the Editor of the Chemical News.

Sir,—The development of atmospheric ozone during the past month has been very abundant. I enclose the particulars of it as indicated by the test-papers, scale 0 to 10:—

December, 1868.

1st.—8·7	9th.—9·2	17th.—7·5	25th.—8·0
2nd.—1·0	10th.—7·5	18th.—7·5	26th.—8·7
3rd.—8·5	11th.—8·5	19th.—8·7	27th.—9·0
4th.—8·0	12th.—9·2	20th.—7·2	28th.—8·5
5th.—9·0	13th.—8·7	21st.—8·7	29th.—8·5
6th.—9·0	14th.—8·7	22nd.—9·2	30th.—6·5
7th.—9·0	15th.—8·7	23rd.—8·7	31st.—8·7
8th.—9·0	16th.—8·2	24th.—8·7	

The test papers used were Schönbein's, as sold by Casella; they were hung on the inside of the roof of my thermometer stand, and were changed every day at 9 a.m.

Some experiments made in 1867 led me to hope—as I mentioned in a short communication to you (Chemical News, No. 425, p. 48—that moistened silver leaf might be used as a test for detecting atmospheric ozone; but further experiments made in the beginning of last year on Beachy Head gave no reliable result.—I am, &c.,

R. C. C. Lippincott, jun., F.M.S.

Over Court, near Bristol,
January 5th, 1869.

MISCELLANEOUS.

Glasgow Philosophical Society (Chemical Section).—A meeting was held in the Hall, Andersonian University, on the evening of the 21st ult., Dr. Wallace, Vice-President, in the chair. Six members were admitted, and six candidates for membership named. W. R. Hutton, Esq., read a paper on the "Igniting Point of the Vapours of some Commercial Products."

Bust of Dr. Muspratt.—The eminent sculptor, Mr. Adams-Acton, is at present executing a portrait bust, in marble, of Dr. Muspratt, the discoverer of the chloride of iron spring, which is to be placed in the New Pump-room at Harrogate, over the "Dr. Muspratt Chalybeate." The artist hopes to have the bust ready for exhibition at the Royal Academy in May next.

Faraday on the Government Recognition of Science.—The Parliamentary Committee of the British Association applied to Faraday through Lord Wrottesley for his opinion whether any and what measures could be adopted by the Government or the Legislature to improve the position of science, or of the cultivators of science, in this country. He answered:—"I feel unfit to give a deliberate opinion.

My course of life, and the circumstances which make it a happy one for me, are not those of persons who conform to the usages and habits of society. Through the kindness of all, from my sovereign downwards, I have that which supplies all my need; and in respect of honours, I have, as a scientific man, received from foreign countries and sovereigns those which, belonging to very limited and select classes, surpass in my opinion anything that it is in the power of my own to bestow. I cannot say that I have not valued such distinctions; on the contrary, I esteem them very highly, but I do not think I have ever worked for or sought them. Even were such to be now created here, the time is passed when these would possess any attraction for me, and you will see, therefore, how unfit I am, upon the strength of any personal motive or feeling, to judge of what might be influential upon the minds of others. Nevertheless I will make one or two remarks which have often occurred to my mind. . . . . A Government should, *for its own sake*, honour the men who do honour and service to the country. The aristocracy of the class should have distinctions which should be unattainable except to that of science. . . . . But, besides, the Government should, in the very many cases which come before it, having a relation to scientific knowledge, employ men who pursue science, provided they are also men of business. This is, perhaps, now done to some extent, but to nothing like the degree which is practicable with advantage to all parties. The right means cannot have occurred to a Government which has not yet learned to approach and distinguish the class as a whole."—*From the Obituary Notice of Faraday in the Proceedings of the Royal Society*, vol. xvii., p. lv.

New Source of Citric Acid.—Professor O. Silvestri of the University of Catana, has recently discovered a great quantity of citric acid in the fruit of the *Cyphomandra betacea*, a plant belonging to the family of *Solanaceæ* which is found here and there in the gardens of Sicily. It is indigenous to Mexico, and has spread itself into Peru and other parts of South America, where it is called *Tomate de la pas*. It is a woody plant, and attains to the height of 4 metres. On analysis the fruit gives from 1 to 1·5 per cent of pure citric acid. This acid, which probably exists also in our edible tomato, has already been discovered by Bertagnini in the potato, and will doubtless be found in all plants belonging to this tribe.—*Cosmos*.

The Preservation of Meat.—The following is a copy of a decree, issued by the Argentine Government, which has been received through her Majesty's Minister at Buenos Ayres, offering a prize of £1,600 to the inventor or improver of the best method of preserving meat:—

"*Decree.—Buenos Ayres, Nov.* 2, 1868.

"In pursuance of the authority given to the executive power, by the law of the National Congress of the 7th September, to apply the sum of 8,000 hard dollars to a prize, to be given to the inventor or introducer of the system of preserving fresh meat, best adapted, in the judgment of the executive power, to its working on a great scale, the President of the Republic decrees that a term of six months is fixed, reckoned from this date, in order that those who shall consider themselves in a position to try for this prize may present their proposals, within that time, to the Ministry, to be examined in the way the Government may think fit.—" (Signed) SARMIENTO DALMATIUS VELEZ SARSFIELD."

NOTES AND QUERIES.

Siam.—Your correspondent, "Oriens," who desires information about the kingdom of Siam, will, perhaps, most readily obtain the information he requires by either politely addressing the Right Hon. Sir J. Bowring, who, according to the "Almanach de Gotha" for 1869, is the Envoy Extraordinary and Minister Plenipotentiary for Siam to the Court of St. James's, or by applying to D. M. Mason, Esq., Consul for Siam, residing in London.—D.

Vitriol Chambers.—"G. N." wants to know the best shape for vitriol or sulphuric acid chambers. Without entering into details concerning the theory and practice of the manufacture of sulphuric acid, full particulars of which are given in Richardson, Watts, and Knapp's "Technology," it may be briefly stated that the shape usually adopted has been found to answer the purpose best, because it best admits the proper play of reactions to take place between the various materials, which results in the formation of sulphuric acid; if, instead of sulphur, sulphur ores (pyrites) are used, the capacity of the chambers should be relatively larger to obtain the same quantity. The shape adopted for sulphuric acid chambers has been found on experience to be not only the most suitable, but the only practically suitable for success on the large scale.—Dr. A. A.

MEETINGS FOR THE WEEK.

MONDAY, 18th.—Medical, 8.
—— London Institution, 6.

TUESDAY, 19th.—Royal Institution, 3. Mr. Westmacott, "On Fine Art."

WEDNESDAY, 20th—Meteorological, 7.
—— Society of Arts, 8.

THURSDAY, 21st.—Royal Institution, 3. Mr. Rupert Jones, "On Entozoa."
—— London Institution, 6.
—— Royal, 8½.
—— Zoological, 4.
—— Chemical, 8.
—— Royal Society Club, 6.

FRIDAY, 22nd.—Royal Institution, 8. Prof. Herschel, "On the Last Eclipse of the Sun."
—— Quekett Club, 8.

SATURDAY, 23rd.—Royal Institution, 3. Professor Odling, F.R.S., "On Hydrogen and its Analogues."

TO CORRESPONDENTS.

*** VOL. XVIII. of THE CHEMICAL NEWS, containing a copious index, is now ready, price 11*s*., by post, 11*s*. 6*d*., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1*s*. 6*d*. Subscribers may have their copies bound for 2*s*. 6*d*. if sent to our office, or, if accompanied by a cloth case, for 1*s*. Subscribers wishing to complete their sets of volumes, are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xix. commenced on January 1st, and will be complete in twenty-six numbers. It will contain a verbatim report of Dr. Odling's Juvenile Lectures at the Royal Institution "On the Chemical Changes of Carbon," and original papers from some of our leading English and Foreign Chemists and Physicists.

J. Wallace.—The *Bulletin de la Société Industrielle de Mulhouse* can be obtained through any foreign bookseller, or it can be seen at the Patent Office Library, Chancery Lane.

Dr. J. Hirsch.—Our correspondent's communication on "Carbolic Acid" is duly received, and shall be inserted in an early number.

R. F. Wheeler.—Messrs. Prentice and Co., Stowmarket, supply all the preparations of gun cotton. We are not able to inform you where dynamite is to be procured.

C. Horner.—1. A Bunsen burner is preferable to a spirit lamp for experiments in spectrum analysis. If you require more heat, use a fine blow-pipe flame, but nothing will replace the induction coil for experimenting on many metallic compounds. 2. In making oxygen from manganese and chlorate of potash there is no danger provided the exit pipes are wide enough to avoid getting blocked up. 3. A glass retort will not do to decompose binoxide of barium in by heat.

J. Brode and Co.—There will be no loss of delicacy if you replace the steel knife edges of your balances by agate. We have used agate edges on agate planes for years, and prefer them to steel on agate, as they do not detoriate in a laboratory. The shape of the knife edges is the same in each case. You will find it advisable to have the alteration done by a workman experienced in the manufacture of balances, as they will be sure to require re-adjustment.

Communications have been received from Dr. R. Angus Smith, F.R.S.; G. F. Rodwell; S. Mellor; W. T. Suffolk; G. Foord; G. Marrison; R. F. Wheeler; G. Wharton Simpson, M.A.; Dr. Sheridan Muspratt; Dr. Joseph Hirsch, Chicago; J. Wallace; Messrs. Muir, Brown, and Co.; C. Horner; Dr. Otto Richter; J. Brode and Co.; Dr. E. Röhrig; R. E. Tatlock: E. C. C. Stanford; J. Morris (with enclosure); W. Briggs (with enclosure); R. Mallet, F.R.S.; Stanislas Meunier; J. and E. Sturge; J. A. Brand; M. A. Gage; G. Maxwell; Muspratt, Bros., and Huntley; A. Hedley; T. Blair; C. Barrett (with enclosure); J. Morris (with enclosure); and J. Wallace (with enclosure).

THE CHEMICAL NEWS.

VOL. XIX. No. 477.

ON THE CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,

(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE II.

CARBONIC GAS—AIR—OXIDES.

(Continued from page 28.)

I WANT now to consider how it is that this carbonic gas gets into the air—by what process charcoal is converted into carbonic gas, and how the air comes to contain it; and for this purpose it is necessary that we should again turn our attention away from charcoal and consider for a few minutes the nature of air. I must here call your attention to some historical facts in connection with it. What sort of a substance is air?

The first point to which I want to call your attention is that air is a real material substance. At the commencement of my first lecture I told you that you had come to the Royal Instituton to learn about *things*—about things that could be touched and weighed. Now I am talking to you about air. Is air a *thing*—something that can be touched and weighed? Let us begin gradually; if we take a block of wood and press it between our hands, we find that it is sensible to the touch. This capability of being felt has received various names. Sometimes it is called "impenetrability," because one body cannot occupy or penetrate the space that is being occupied by another body; sometimes it is called "extension," because the body extends, between my hands for instance, and keeps them apart; and it is more commonly called "resistance," because the substance resists, as this wood does, my hands. Whether you call this property inpenetrability, extension, or resistance, the word means the same thing. It means that the body is capable of being felt. A solid body, we know, is capable of being felt; but when we come to the case of sand, and when I press it between my hands, it does not keep my hands apart like the block of wood. Hence you might say at first sight that the sand does not possess this property of impenetrability or extension or resistance; but if we put the sand into a bag so that it cannot make way for my fingers, it then keeps my fingers apart, and resists the pressure of them just as the block of wood did, and so we must say that it has impenetrability. A tight bag of sand might be regarded almost as a hard solid substance; it is capable of striking a very heavy blow, and, indeed, was formerly used for that purpose. When we pass from such a substance as sand to a liquid substance like water, we find that it keeps the hands apart still less forcibly than the sand, and you may say that it is perfectly penetrable. Well, it is penetrable in one sense, but not in another. If I put water into a bladder, the water not being able then to make way for my fingers will keep them apart, and that is what we call the capability of being felt—the property of impenetrability or extension. Again, we cannot, under ordinary circumstances, feel the air, but if the air is placed in a bag, like sand or water, we can feel it perfectly well. Here I have a bladder of air, and I can feel that there is something in it which my fingers cannot penetrate—which resists their pressure—which extends between them, and therefore we say that the air is possessed of this capability of being felt which constitutes it a *thing*. But is it also capable of being weighed? Can we weigh air? I think we can. Here is a flask from which the air has been removed by a means to which I do not intend now to direct your attention. We place this flask on a balance, and it is now more than balanced by a weight on the opposite side, for the weight is heavier than the flask. I will let the air rush into the flask, and you will see under these circumstances that the flask will become heavier than the weight: at present the counterpoise is heavier than the flask. Now listen!—[opening the stopcock to admit the air.] You hear the air going in, and you see that the flask becomes heavier than the weight on the other side of the balance.

Not only is air possessed of weight, but it is really very heavy. A cubic foot of air weighs something between an ounce and an ounce and a quarter. You might think that we ought to be able to feel its weight, and here I will devote a few minutes to explaining to you the recognition of atmospheric air as a material substance. Thoughtful people in all ages have taken notice of the air, but there must have been a lapse of at least 2,000 years between the first scientific notice of the air and the discovery of the fact that the air was a thing or substance. It was not until the year 1643 that atmospheric air was recognised to be a substance possessed of weight and capable of being felt, so that,

* Reported verbatim, by permission of the Author, for this Journal.

although the air is a weighty substance, yet its weight is not very easily appreciated. You are not yourselves conscious of its being weighty, and for 2,000 years after mankind had begun to think of it, and perhaps for as many years before, they were quite unconscious that it was a substance possessed of weight. They said that if it was weighty its weight ought to be perceptible. Now the reverse is the truth; if it is weighty you ought *not* to feel it. It would take me too long to explain this to you, so I will give you an illustration instead, and I want you all to see it. This is a large tube closed with a bladder; at present it is nearly full of coloured water, and it is quite obvious that the bladder has to support the weight of the water, and from this cause you see it becomes extremely taut, and shows unmistakable evidence of the water pressing upon it. If I lower the tube into this jar containing colourless water so that the water is as high outside as it is inside, you will see that the bladder becomes unconscious of the weight of the water. There is water as before, but still the water on each side is so exactly balanced that the bladder is no longer conscious of it. Now again, [lifting the tube out] the bladder is extremely taut: very likely a little more will burst it; but directly I lower it into the vessel so as to have the water level on the inside and on the outside of the tube, the bladder becomes perfectly flaccid and insensible to the weight of the water, just as we are insensible of the weight of the air by which we are surrounded. Take another illustration. In each of the pans of this balance is a pound weight, and the pans now perfectly balance one another. Under ordinary circumstances a feather would be quite incapable of raising a pound weight; but in this instance you will see that it will suffice to do so. If I take this feather in my hand and gently raise it under one of the pans containing a pound weight, it raises it up above the other; the reason of this is that the weight on one side is so exactly balanced by that on the other side, that the feather is not sensible of the weight it is moving. In the same way we are insensible of the weight of the air in which we live, because really that weight is not supported by ourselves, but by that of the surrounding air. So much, then, for the question of the weight of air.

The discovery of the weight of the air was made in 1643; from the year 1643 to the year 1756 mankind were of opinion that there was only one kind of air, although many of them knew that air could differ in some respects. They were aware, for instance, that the air of the town differed from that of the sea—that some air had different properties from other air; but they never recognised these different kinds of air as distinct substances. They rather looked upon the difference as being of a similar kind as that between different sorts of water. You know there are rain water, river water, sea water, and spring water; but all these consist essentially of the same substance—water—together with certain impurities. Well, from the year 1643 to 1756 mankind thought there was but one kind of air, and that the differences were due to impurities which gave the various airs a different character, just as sea water differs from common water because there is a little sea-salt dissolved in it, and so on. In reality, however, there are essentially different kinds of air. First of all, we find that there are airs of different colours; here is some of a decidedly green colour; in this other bottle we have some of of a brown colour—so that we are acquainted not only with colourless air, but with airs of different colours, just as we may have liquids of different colours; but when we recognise no difference by the colours of air, we may recognise them by other means. For instance, if I take a taper and introduce it into what we call an empty bottle—that is, a bottle containing ordinary air—the taper continues to burn perfectly well, but if I take it out of this bottle containing ordinary air, and insert it into this other bottle, we find that the taper is at once extinguished by our old friend, fixed air, or carbonic gas; and this was the first air discovered as differing from ordinary air. It was discovered in 1756, and it differs from ordinary air in containing carbon.

We will now take another kind of air, which is colourless, and looks like ordinary air; we will apply a light to it and try what will be the effect—whether our light will continue to burn. [On the experiment being tried, the light was immediately extinguished.]

This, then, is a third kind called *azotic* air. Those of you who are Greek scholars will know that azotic air means lifeless air, and it was so called because it will not support life; it has also been called *phlogistic* air; it is now termed *nitrogen* gas, because it is capable of producing, or being produced from, nitre.

Here we have some air, which, when a light is applied to it, burns with a flame. This air was originally called inflammable air; it is now called *hydrogen* gas, because it enters into the composition of water.

You saw that when I introduced the taper into the azotic air, or nitrogen gas, the light at once went out. In this respect, then, azotic air behaves exactly like carbonic gas; but it differs from carbonic gas in this particular—that it is not capable of being fixed by means of lime-water. We will shake up some of this gas with lime-water, and you observe that the lime-water remains perfectly clear; whereas, if we had taken the bottle containing carbonic acid,

the lime-water would have become milky, in consequence of the formation of chalk. Therefore this azotic air corresponds with the fixed air in not allowing bodies to burn it, but it differs from the fixed air in not rendering the lime-water turbid.

We now come to another kind of air. It was discovered in 1774, and was originally called *vital air*; we now call it *oxygen* gas. On introducing the lighted taper into this oxygen, we shall see whether the taper burns as in ordinary air, whether the gas takes fire, or what happens to the taper. We introduce it, and you see with what increased brilliancy the taper burns. This, then, is a fourth kind of air we are dealing with.

I will finally call your attention to a fifth kind of air, called *marsh* gas; this is an essential constituent of ordinary coal gas. You are all familiar with the appearance coal gas presents when it is being used in the ordinary way for lighting. You observe, when we set fire to this marsh gas, it at once burns in a similar way. It was originally called heavy inflammable air, because it is much heavier than ordinary inflammable air, or hydrogen. Thus, you see, chemists are acquainted with a variety of kinds of air.

We will return to this fixed air, or carbonic gas, or gas from charcoal, and the way in which it gets into the atmosphere. And this leads me to make some remarks on the miscibility of different kinds of air with each other. I will illustrate this by reference to certain liquids, and first let me call your attention to this cylinder, at the bottom of which I have poured some of the heavy liquid mercury. Upon the mercury is the colourless liquid chloroform, which is also heavy; and then upon that some water, which I have coloured in order to make it more evident. Thus we have three different liquids in the cylinder, standing in layers one upon the other, and not capable of mixing. If I put a stick into them, and stir them up, they soon settle again into distinct layers. I can even pour upon the water another liquid—ether—and in this way we shall have four immiscible liquids together in the jar. Thus we have four liquids in the vessel—mercury at the bottom, chloroform next, then the coloured water, and the colourless ether at the top—four liquids which are not capable of mixing. There are, however, certain other liquids which are capable of mixing with each other, and I will now draw your attention to some of them. Here I have another cylinder, with some coloured liquid at the bottom and some colourless liquid at the top; the first is coloured water, and the other is spirit of wine. If I stir up these liquids, they mix, and will not again separate. Now here is a cylinder which looks at first sight as if it contained only one liquid, but, in point of fact, it contains two—water at the bottom and spirit of wine at the top; and I daresay I can render this evident to you. If I introduce into the cylinder a piece of wax, and allow it to drop gently into the liquid, you see it drops only half way; the wax drops through the spirit of wine, for it is heavier; but being lighter than the water, it floats on the top of it. In such cases, although the liquids are capable of mixing when one is lighter than the other, you may, by using care, put the lighter liquid at the top of the heavier one. Now, if I shake these together, we shall get a mixture of spirit and water containing so much water that the wax at once floats at the top. In point of fact, then, these liquids do not differ so much from one another with regard to their miscibility as the liquids to which I first called your attention. With regard to liquids, we find, then, that some will mix and others will not. With regard to gases, however, we found that all gases will mix; we can put one gas at the top of another, and keep it so for a short space, but after a time the two gases will mix completely. For instance, here is a brown-coloured gas. Now I can put on the top of this a cylinder of air, and we shall have in that way a colourless gas floating on the top of a coloured gas, just as we had a coloured liquid floating on the top of a colourless one; but you will observe that the brown gas will gradually mix with the colourless gas, even without much agitation.

We will now take another illustration, and one in which we shall be able to make a comparison similar to the floating of the piece of wax on the surface of the lower liquid. Here is a cylinder apparently empty, but in reality containing at the bottom of it some fixed air, and the upper portion of the cylinder is filled with ordinary air. Thus we have two colourless gases in that cylinder just as we had two colourless liquids in the vessel we had before us just now. I shall be able to show you the point to which the lower gas rises. If we introduce into this cylinder a jet of burning gas, it burns perfectly well while in the air, but when we allow it to go a little lower it comes into the fixed air, and the flame is immediately extinguished. You see, then, that this jet of flame finds out the margin of the heavy and the light gas just as the wax found out the limit of the two liquids. Directly this flame is lowered into the carbonic gas it ceases to burn. You see, therefore, that you may have in the same cylinder two different airs floating one on the top of the other, just as you may have two liquids one on the top of the other; but eventually you will find in the case of the gases that, whether they are in a state of agitation or in a state of rest, they will mix perfectly with each other.

Now comes the question,—is the ordinary atmospheric air with which we have to deal a single gas or a mixture of different gases? I might call your attention to a great many experiments illustrative of the fact, that ordinary atmospheric air is really a mixture; and here is one. You know that many metals have the property of rusting. Some of them rust very quickly, like iron: others of them rust very slowly, like mercury, copper, or silver. Now, if you take such a metal as iron, which rusts tolerably quickly, and put it into a confined space of air, the iron gradually rusts, and as it rusts the volume of air grows less and less until, in fact, the five volumes of air are reduced to four; now, this has taken place in the present instance. Here you have a cylinder which was full of air; some iron wire was put into it, and it has at last sucked up one-fifth of the air. Here, again, is a piece of phosphorus on the end of a stick, and this piece of phosphorus is rusting just in the same way. The phosphorus will go on rusting until the liquid in the cylinder rises up one-fifth, and then the rusting will entirely stop. We find, then, that one-fifth of the bulk of the air is capable of being absorbed by rusting iron and by rusting phosphorus, and also by burning phosphorus. We will take some phosphorus and burn it under a cylinder inverted over water. We dry a small piece of phosphorus on a piece of paper, and place it on a piece of cork, and burn it under the cylinder, and as it burns you will find that the water will gradually rise in the cylinder until it reaches one-fifth of the way up. [The experiment was performed with the result described.] Now, instead of burning a piece of phosphorus, I will in the same way burn a piece of candle also floating upon cork, and you will see, as before, that as the candle burns the water rises in the glass vessel.

I must defer further consideration of this property of different kinds of gas to mix with one another to my next lecture; but before I conclude I wish to show you two more experiments in illustration of my lecture.

First of all, I told you that air is a material substance. Here you have an illustration of it; here is a flask of coloured water inverted over what appears to be an empty bottle, and the neck of the upper flask communicates with the neck of the vessel underneath. Now why does not the water run out into this lower flask? Because that flask is *already full*. It is already full of air, and the air cannot get out, and therefore the water from the upper bottle cannot get in; but if I just for a moment allow the air to escape from the lower flask, the water will run in from the upper vessel. If I close the receiver, you see that in a moment or two the water ceases to run, because the air contained in the receiver cannot escape to make room for it.

The other experiment is one intended to illustrate the way in which air tends to magnify the appearance of some substances. Here we have a large glass jar which appears to be full of cotton wool. In reality cotton wool occupies a very small portion of the jar, which is filled chiefly with air. I daresay you will be surprised to find that the whole of the wool may easily be put into this cylinder which seems to be already almost full of spirit. [The smaller cylinder was of about one-eighth the capacity of the large cylinder containing the dry wool, and was nearly full of spirit of wine.] We will colour the spirit blue to make it visible to you all. [The lecturer then began to transfer the wool from the large jar into the small vessel containing the spirit; the wool so transferred was compressed at the bottom of the liquid by means of a glass rod. After continuing the operation for a short time the lecturer proceeded,—] We have put a large portion of the wool into the cylinder, but the cylinder is not full; it is apparently no fuller than it was before, and if I put the wool in carefully I shall be able to go on until the whole of the wool is transferred.

FORMATION OF AN ARTIFICIAL SPECTRUM WITH A FRAUNHOFER LINE.

By A. WALLNER.

If, by means of a Holtz machine, at a short distance, the rapid discharges of a Leyden jar of about 30 square centimes are passed into an ordinary Geissler tube, and if the tube is placed before the slit of a spectroscope, the spectrum of the gas which fills the tube is first seen. If the length of the discharge is increased a little, the sodium line immediately appears as in the case of induction currents, by heating the capillary part of the tube placed before the slit. With a proper length of spark the brilliancy of the sodium line far exceeds that of the spectrum of the gas. By further increasing the distance of the discharge, the calcium line is produced with such intensity that it cannot be seen to greater advantage by any way hitherto known. Finally, if the length of the spark is again augmented, the phenomenon changes, the light in the tube assumes a dazzling splendour, this luminous line forms a continuous brilliant spectrum in which the spectroscope reveals a completely black line instead of the sodium line; this, therefore, is a Fraunhofer line. If the tube is attentively examined after this experiment, one can connect the phenomenon with the explanation which M. Kirchhoff has given of the spectrum rays. The inner surface of the capillary tube is thickly corroded in consequence of the particles of glass taken away by each discharge, so that by prolonging the experiment, the glass may be completely roughened. These particles immediately raised to incandescence by the discharge, give the sodium line; but soon the tube is filled with sodium vapours, which then absorb the light proceeding from the solid incandescent particles; these form a kind of solid incandescent nucleus surrounded by an atmosphere of vapour.—*Ann. de Pogg.*, cxxxv.

ON AN OXALATE OF MANGANESE.

By Prof. HOW, D.C.L., Windsor, Nova Scotia.

HAVING, in the course of some experiments on manganese, of which an account may soon appear, observed the formation of an oxalate of the metal, which does not seem to have been accurately analysed, I offer the following notice of the salt. The only analytical detail I have been able to find on the subject is in Gerhardt's "Traité de Chimie Organique," vol. i, p. 254, where this statement occurs:—"*Oxalates de Manganèse.*—Lorsqu'on fait dissoudre le carbonate manganeux dans l'acide oxalique, il se dépose dans la liqueur une poudre blanche, légerèment rosée et crystalline, presque insoluble dans l'eau. Elle paraît contenir 5 atomes d'eau de crystallisation." I think, for reasons now to be given, that the composition of the salt is not as it is thus said to appear. The subject of my communication was formed by precipitation.

When a strong solution of oxalic acid is added to one of sulphate of manganese, in the cold, an almost immediate precipitate of colourless needles begins to form, which becomes more abundant on standing. When neutral oxalate of ammonium is added to excess of sulphate of manganese and the mixture is briskly stirred, a copious white powdery deposit results, which is seen under the microscope to consist of minute needles. Almost the whole precipitate falls in a few minutes, and when it is deposited no oxalic acid can be detected in the solution by salts of calcium. The crystalline deposits from such acid and neutral fluids consist of the same oxalate of manganese; the salt has a pale rose tint when collected.

In the following analyses the water was determined at 212°, the manganese by ignition. The accurate estimation of the oxalic acid was not attained, because the salt is insoluble in acetic acid and is decomposed by ammonia, apparently with formation, according to Gerhardt, of a double oxalate of ammonium and manganos-ammonium. In the two attempts made, one by adding to the salt first acetic acid, then excess of NH_3, filtration from a small flocky precipitate, and subsequent addition of $CaCl_2$ and acetic acid, the other by solution of the salt in dilute HCl, and consecutive addition of chloride of calcium and acetate of potassium, the oxalate of calcium formed contained manganese. The salt was analysed in the air dry state; the result under I. was from a deposit from the neutral, the other numbers were from the crystals formed in the acid fluid described:—

	Calc.		Found.		
			I.	II.	III.
MnO	= 71	36·04	36·90	35·97	37·10
C_2O_3	= 72	36·55			
$3H_2O$	= 54	27·41			26·72
	197	100·00	100·00	100·00	100·00

The experimental percentages obviously agree with those calculated, hence the composition of the salt is shown by the expression:—

$$MnC_2O_4 + 3H_2O.$$

As regards the statement of Gerhardt above given, which refers to a salt resembling that now described, doubtless the same, I find the theoretical percentage belonging to the formula assigned to the salt, which is, in the notation of the period, $2(C_2O_3,MnO) + 5$ aq., is 23·93, and I think the loss at 212° must have agreed with this, while a prolonged heating at that temperature would have brought the amount up to that given above. I say this because I have found that the salt of different preparations gives off the first quantities of water with unequal facility, and sometimes loses the rest so slowly that if weighed at short intervals it may be considered dry when it is not so. In my examination I thought I had at least two or three definite hydrates at 212°, but found eventually that all the water is really expelled at this temperature. The salt is efflorescent to a certain extent, and hence generally gives too little H_2O and too much MnO on analysis. It has a neutral reaction, and does not dissolve in boiling water. It is curious to find this salt forming in presence of free sulphuric acid. I believe it not to be the only oxalate of manganese, for I have observed the formation of transparent granules, either globular or polyhedral with very small faces, among the needles in the neutral fluid, mentioned above, left standing. The oxalate analysed dissolves only partially in solution of oxalic acid on boiling.

FORMATION OF ELLAGIC ACID BY MEANS OF GALLIC ACID.

By M. J. LÖWE.

BY heating nearly to the boiling point for several hours in an aqueous solution of two equivalents of gallic acid and one of arsenic acid, a crystalline precipitate is deposited, which is none other than ellagic acid; the best way is to mix the two acids in the proportion indicated above, add water, evaporate to dryness, heat in an air bath to 120°, and extract with alcohol at 90°, which does not dissolve ellagic acid. The reaction is the following—

$$C_{28}H_{12}O_{20} + 2O = C_{28}H_6O_{16} + 6HO.$$

In commercial tannin there is always gallic acid, and consequently ellagic acid which proceeds from it. A cold extract of oak bark gives by degrees a yellow deposit of ellagic acid, and it is, indeed, this same acid which constitutes that gelatinous covering which is formed over tanned hides.—*Journ. de Chim. Prat.*

ON THE IGNITING POINT OF THE VAPOURS OF SOME COMMERCIAL PRODUCTS.*

By W. R. HUTTON, Esq.

IT is a well-known fact that many commercial products at certain temperatures give off an inflammable vapour, and my object in bringing this paper before the Chemical Section is to give the results of comparative trials of the igniting points of a few of the leading articles of commerce, and also to explain the method employed by me in testing, which is very simple and sufficiently accurate.

In commerce there are several substances which, at the ordinary temperature of the atmosphere, are sufficiently volatile to emit enough vapour to form, with atmospheric air, an explosive mixture. There are many others which do not volatilise at quite so low a temperature, but which in a warm room, or exposed to the sun's rays, do give off vapours sufficient to render them dangerous; and there are others, again, that require to be considerably raised in temperature ere vapour is evolved, and, in consequence, may be considered sufficiently safe where ordinary care is employed.

I wish it to be distinctly understood that it is the vapour evolved from ordinary commercial substances, and not the point at which the substance itself will ignite that my results refer to. To illustrate the difference in the igniting point of the vapours evolved from different articles of commerce, I pour into one glass a small quantity of sulphuric ether, and into another glass the same volume of ordinary paraffin oil. The one substance —ether—is known to be very volatile, and on bringing a light to within half an inch of its surface an explosion takes place; the other—paraffin oil—is found not to be explosive at the temperature of this room, as it requires

* Read before the Chemical Section of the Glasgow Philosophical Society, Dec. 21st, 1868.

a higher temperature to evolve vapour before an explosion will take place.

In the subjoined table, shewing the results of experiments made by me, the samples having been purchased in the usual way, I give the specific gravity of the different commercial products, and the temperature at which their vapour explodes when a lighted taper is kept at 1½ inches from the surface; and also the temperature at which the vapour explodes when the lighted taper is kept at only half an inch from the surface:—

IGNITING POINT OF THE VAPOURS OF SOME COMMERCIAL PRODUCTS.

	Specific Gravity.		Taper 1½ inches from Liquid. °F.	Taper ½ inch from Liquid. °F.
Sulphuric ether	·747	under	53	—
Bisulphide of carbon	1·270	—	53	—
Petroleum spirit	·706	—	53	—
Paraffin spirit	·751	—	70	68
Benzole, 90 per cent.	·861	—	74	71
Crude paraffin oil	·849	—	74	72
Ditto naphtha	·884	—	78	74
Brandy	·940	—	—	85
Wood naphtha	·840	—	88	81
Crude paraffin oil	·891	—	89	84
Ditto naphtha	·881	—	90	86
Holland gin	·930	—	—	90
Rum	·936	—	—	90
Methylated spirit	·827	—	97	86
Burning coal naphtha	·859	—	100	91
Spirit of wine	·817	—	104	73
Whisky, 25 O.P.	·893	—	109	83
Ditto 11 O.P.	·905	—	110	84
Petroleum oil	·801	—	118	110
Light pitch oil	·920	—	119	109
Resin spirit	·922	—	122	106
Turpentine	·875	—	130	119
Sherry wine	·993	—	—	130
Port wine	1·003	—	—	130
Refined paraffin oil	·809	—	134	123
Ditto	·814	—	138	127
Fusel oil	·850	—	140	129
Resin oil	·987	over	212	—
Heavy pitch oil	·950	—	212	—

It will be observed that the specific gravity bears no relation to the temperature required to expel vapour from many of the products mentioned in the table, and this, in some instances, arises from the fact that they are not isolated chemical substances, but consist of distinct compound bodies mixed together, the lighter of which usually, but not always, distils off first. This is very well shown from the results obtained in experimenting on the two samples of crude and the sample of burning naphtha, the benzole having been separated from the latter by fractional distillation. In the crude naphtha, there always exists a large proportion of tarry matter and naphthaline, and with a gravity approaching to ·890 as compared with burning naphtha, which has been freed from all tarry matter, and has a gravity not exceeding ·860; it is not to be expected that the crude will give off vapour as readily as the refined. This has been the case, however, as is indicated by the table of results. The crude gave off vapour at a much lower temperature than the refined burning naphtha; and the same remark applies to the results obtained from crude and refined paraffin oils from which paraffin spirit has been separated. In the case of spirit of wine and different proportions of water, and also of liquids that will mix with water, a deduction from the specific gravity might be made, which would at once indicate the igniting point of the vapour, and also the percentage of spirit in it; this, however, I have not gone into. The proportion of volatile matters to be found in different crude commercial substances is exceedingly variable, and therefore no line for guidance do I offer; but in manufactured articles of commerce, where a volatile and a less volatile mixture are together, the manufacturer and the merchant have it in their power to exact a standard at which the vapour will not ignite. A very small percentage of a volatile compound is sufficient to make the whole bulk dangerous, and in some instances accidents from this circumstance are very apt to arise. In the printed table I have light pitch oil, the vapour of which explodes at 119° F.; this point of ignition is not what is considered at all dangerous as compared with bisulphide of carbon or benzole; it is, however, equally dangerous, and for this reason—that the latter is known to give off inflammable vapour which ignites at a low temperature, while the former, on account of its familiar name—pitch oil, or creosote—is looked upon as not at all explosive. In this sample of light pitch oil, the volatile matter which gave off inflammable gas at 119° did not exceed 2 per cent, after which no combustible vapour was given off until a temperature of 180° was reached, thus clearly showing that the low explosive points of the vapours of some commercial substances depend upon a very small percentage of volatile extraneous matter.

Now I shall explain the small apparatus used in estimating the igniting point of the vapours, and which is very simple.

It consists of a water-bath, with basin thermometer and spirit lamp. In operating, I put the same quantity of cold water into the bath each trial, in order that the time required to raise the temperature of the water is as nearly as possible the same. Into the small basin I put a known measure of the liquid under examination (in this instance, also, the same volume is always used); the thermometer is then adjusted with the bulb immersed under the liquid in the basin. The spirit lamp is now lighted and placed under the bath—the water in the bath is gradually warmed, which, in its turn, heats the liquid under trial. The rise of temperature is indicated by the thermometer, and by means of a lighted taper and careful attention it is easy to catch the first flash of vapour evolved. In order to have exact comparative trials, it is not only essential to have all the experiments conducted on the same principle, as regards detail, but it is also of the greatest importance that the surface of the liquid, and the taper used in catching the exact point at which the vapour explodes, shall be at an equal distance in each case. This point is of the first importance to all who test the igniting point of vapours; and to explain this statement more clearly, I have printed on the table the results of experiments made on the same commercial samples, keeping the lighted taper 1½ inches from the surface of the liquid, in one case, and in the other at only half an inch from the surface of the sample under trial. The results are as expected—when the vapour has to diffuse and mix with atmospheric air through a space of 1½ inches, it is found that a greater temperature is required in order to evolve the larger quantity of vapour, than in the experiments of only half an inch between the lighted taper and sample; and this is explained by the circumstance that the vapour, immediately on being liberated, mixes with the small volume of atmospheric air in the experimental basin, forming with it a mixture which, on meeting a light, explodes. In the other set of experiments, a greater temperature is required to disengage a larger volume of vapour to mix with the greater proportion of air.

In this paper I have carefully avoided mention of the relative danger of the articles of commerce examined by me; the table gives, however, the names of several compounds the vapours of which readily explode, and it is with the object of having a uniform method of testing that point of danger that I now submit a method which I consider sufficiently accurate for all comparative trials. Without a uniform method no two results will agree; but with a recognised method, both manufacturers and merchants would know what the igniting point of the vapour of commercial substances exactly means, and a

security to consumers and others that does not now exist would be obtained.

Note.—The Petroleum Act of 1868 enforces a uniform method of testing the point at which vapours are evolved to form explosive mixtures with air; but this applies only to paraffin, petroleum, and coal oil products, and does not refer to other commercial substances, several of which are equally, and others more dangerous, than paraffin and petroleum oil.

Dr. Wallace gave additional information relating to the new Petroleum Act, and described the apparatus which must be used for testing in order to conform to its requirements.

Dr. Clarke stated that, in the case of liquids having a low inflaming point, the temperature at which the first flash took place was generally only a few degrees below that at which the bulk of the liquid was inflammable, but that with liquids which had a high inflaming point, the temperature at which the first flash took place was removed from that at which the liquid itself inflamed, by 10° or even more. He also stated that he believed the insurance companies had divided oils into three classes, having different inflaming points—the first, or least inflammable, being represented by olive oil; the second, by Price's cloth oil, which ignites at about 346° F.; and the third embracing all oils having a lower igniting point than Price's cloth oil, a margin of a few degrees being allowed. He also pointed out that the igniting point of an oil (the only test required by insurance companies) was no criterion of the readiness with which it undergoes spontaneous combustion when spread over a cotton surface.

Mr. Tatlock believed that much misapprehension had arisen from a misunderstanding on the part of commercial men as to the true meaning of the term "igniting point," and referred to the fact that the igniting point, properly so-called, of any gas or vapour was seldom, if ever, under a red heat, whereas the igniting point, commercially speaking, was simply the point at which sufficient vapour was given off to form an explosive mixture with air in contact with a red-hot body, the latter condition requiring always to be fulfilled before an explosion could happen.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

November 9th, 1868.

J. B. Dancer, F.R.A.S., President of the Section, in the Chair.

Mr. Sidebotham exhibited specimens of the gall fly, *Cynips Lignicola* and a number of the galls formed by this species. He stated that these galls are very common, apparently much more so than a few years ago; he had tried an experiment to ascertain their commercial value, and exhibited the comparative strength of colour from them and from the blue Aleppo galls. The English galls are much lighter, and in the experiment equal weights of each were used. The result of the experiments showed that the English galls were about two-thirds the value of the foreign ones, or, according to the present market value, they would be worth about 66s. a hundredweight. In the plantations where these galls abound, he thought a man might collect easily half a hundredweight in a day, and, on the principle that nothing valuable should be wasted, he thought that it was very desirable that these galls should be collected and made use of. The galls, even when in great numbers, do not appear to injure the trees. The proper time to collect them would be the middle of September, when the flies have all eaten their way out and laid their eggs for another year's supply.

Dr. Alcock showed a preparation preserved by corrosive sublimate in a manner which he recommended for fine dissections. The preparation had been kept in an open cup for twelve months, simply water being added occasionally to supply what was lost by evaporation. The advantages of the plan were, very perfect preservation, no necessity for closing up so that the specimen could not be got at, no fear of losing a valuable dissection from accidental evaporation, as where spirit is used, and cheapness. The method adopted was to prepare a saturated solution of corrosive sublimate in alcohol, and when a dissection in water is in progress, a small quantity, as half a teaspoonful, of the solution is to be added from day to day if the slightest appearance of putrefaction is observed, but no more of it is used than is absolutely necessary, and by the time the dissection is completed, the specimen has become imperishable, from the union of the corrosive sublimate with the tissues, and it may then be kept in pure water, either open or mounted in the usual way.

NEWCASTLE LITERARY AND PHILOSOPHICAL SOCIETY.

On Thursday, December 24th, 1868, Mr. J. Lowthian Bell delivered the inaugural address of the newly-formed Chemical Society. We regret that pressure on our space will only allow us to give a short notice of the address, which is full of scientific interest, and will, we have no doubt, be the means of increasing the zeal of the founders and members of the society. Mr. Bell reviewed the history of the various chemical compounds now manufactured on a very large scale on the banks of the Tyne, and which furnish a field of enquiry and research rarely or never at the command of the man of science. As instances of the advantages possessed by manufacturers for promoting chemical science, the speaker quoted the discovery of selenium and thallium, found in infinitesimal quantities in the slow accumulations of sublimate in our vitriol chambers, while bromine as well as iodine were first noticed in the concentrated mother waters obtained in treating sea water and the incinerated portions of marine plants. Mr. Bell also made some excellent observations on the discoveries of Kirchhoff, Miller, Huggins, Joule, and others in connection with spectrum analysis; on the investigations of Professors Graham and H. St. Claire-Deville on the absorption and dialytic separation of gases by colloid septa; on the production of the submarine cable by insulating copper wire by means of gutta percha; and on Mr. Ansell's ingenious apparatus for indicating the presence of fire-damp in mines. At the conclusion of the address the speaker dwelt at some length on the several means possessed by the members of the society for promoting chemical investigation.

The delivery of the address was frequently interrupted by applause, and Mr. Bell was rewarded with enthusiastic cheering on resuming his seat. Mr. Ladd then, by means of his beautiful apparatus and the electric light, exhibited a variety of spectra, illustrating the existence, in the stars and planets, of various metals, such as silver, copper, zinc, and the new metal thallium—which was discovered by means of the spectroscope. He also projected on the canvas a powerful electric light, and by means of a battery showed the colours of various chemical substances, and produced ozone.

Mr. Glover then proposed a vote of thanks to Mr. Bell for his able and exhaustive lecture. In past times, they had a Hutton, and a Bewick; and, in later times a Hugh Lee Pattinson, famous for his discoveries in the chemistry

of manufactures as applied to lead and the silvering process. They now had Mr. Bell, and as long as they had a gentleman among them capable of delivering an address such as they had heard that evening, they might rest assured that Newcastle would still retain her place in the world of science.

At the conclusion of the meeting a large number of the audience inspected the specimens on the table illustrative of the lecture, and the portfolio of photographs of the works of ancient masters executed by means of Mr. Swan's carbon process.

We hope to furnish our readers regularly with reports of the transactions of the new society.

FOREIGN SCIENCE.

PARIS, Jan. 20, 1869.

Estimation of Urea.—Experiments with Sulphuretted Hydrogen.—Patent for the Extraction of Iodine.—Bleaching of Tissues.

SEVERAL errors are introduced in the estimation of urea when the nitrate of mercury used is prepared by acting upon the metal with nitric acid, the acidity of the titrated solution is variable, and the whole of the compound is not in the condition of mercuric nitrate. M. Byasson makes use of the following modification of Liebig's method:—Exactly 36 grammes of red oxide of mercury are weighed, and dissolved in 50 grammes of ordinary nitric acid diluted with half its weight of water; the solution is gently evaporated until acid vapours appear, and made up with distilled water to the volume of 1 litre, at about 15° C. If the dilution with water should cause a slight turbidity, a few drops of acid will render the solution clear. In this way a solution is obtained in which all the mercury is present as mercuric nitrate, and as little acid as possible. A test solution of urea is prepared by dissolving 20 grammes of crystallised urea in 1 litre of distilled water; 1 c.c. of the mercurial solution already made should correspond to ·005 gramme of urea. During the process, M. Byasson makes use of a solution of 25 grammes of potash in 1 litre, from time to time, to partly neutralise the acid set free; the urea solution must never be rendered alkaline. The potash solution indicates the completion of the reaction, by forming a yellow precipitate on the surface. M. Byasson's results with this process agree remarkably well.

M. Bœttger has made known the following experiments to be realised with sulphuretted hydrogen. A jet of this gas inflames by contact with teroxide of thallium, peroxides of manganese and lead, as well as with the peroxide of silver obtained in powder by a battery. Many chlorates, iodates, and bromates behave similarly. Other compounds occasion a violent explosion, among these acetylide and fulminate of silver and iodide of nitrogen.

A patent has been granted to M. Lauroy for a new method of extracting iodine, and treating the salts derived from kelp. When the lixivium has been freed from the less soluble salts, and concentrated to a density varying between 45° and 55° Baumé, it may contain free alkali, carbonates, sulphides, sulphites, and hyposulphites of alkalies, as well as alkaline iodides and bromides. The treatment varies, according as it is desired to separate the salts contained, or to extract at once the iodine and bromine. When it is desired to extract the iodine and bromine at once, the liquid is saturated with hydrochloric acid; the deposit which forms is separated, and the gaseous mixture which is evolved in the reaction of nitric acid on organic matters (as in the preparation of oxalic acid, picric acid, &c.) introduced. When these gases are principally formed of binoxide of nitrogen, a quantity of air is admixed. The application of the nitrous gases may be made in several ways—sulphuric acid, in which nitrous gases have previously been dissolved, may be added to the liquid, or when the liquor contains sufficient alkali, nitrous acid may be admitted as long as there is absorption, and any acid whatever added afterwards to precipitate the iodine. In whatever way one operates the precipitation of the iodine is determined by the reaction of the nitrous compounds. The precipitation is complete, and the bromine is not set at liberty. When the iodine has been thus separated, the mother liquor is submitted to treatment, and the bromine extracted by the ordinary methods.

Before giving an abstract of a memoir entitled "Researches on the Bleaching of Tissues," your correspondent would remark that the author is M. Kolb, not M. Kolbe. In the rough fibre of flax, there exist, along with cellulose, two distinct substances—the one, pectic acid, is abundant, and possibly completely eliminated by alkalies; the other is a colouring matter which is developed in the steeping. This substance tints the fibre grey, and resists alkalies, as well as all ordinary chemical solvents. It may be isolated by M. Peligot's ammoniacal copper solution. While the pectic products are abundant (15 to 36 per cent), the amount of the grey matter is infinitesimal. Chlorine water and dilute solutions of the hypochlorites decolourise this substance without dissolving it. After decolouration it is still insoluble in alkaline solutions, which remain colourless. When the three constituent parts of the fibre are separately submitted to the action of chlorine water, the following is the result:—(1) the grey matter alone is decolourised by very weak chlorine water; (2) in slightly stronger chlorine water the cellulose is disintegrated and then attacked, gradually passing into water and carbonic acid; (3) the brown pectic products are only decolourised by decomposition in very much stronger chlorine water, and long after the alteration of the cellulose. From this it results that, in bleaching, chlorine is necessary for the destruction of the grey colouration, while this reagent must not be reckoned upon for removing the yellow tint. Theoretically, perfect bleaching is reduced to two operations—(1) removal of all yellow colouring matter by rigorous exhaustion with alkalies; (2) oxidation, which simply decolourises the grey matter, but without rendering it soluble in lyes, as hitherto supposed. Chlorine water, oxygenated water, and ozone, dry or humid, effect bleaching; but is this phenomenon due to an absorption of oxygen by the colouring matter, or to a removal of hydrogen? Experiments show that there is absorption of oxygen. Chlorine water can only be employed without danger very dilute, and at the greatest strength marking 10 chlorimetric degrees. Oxygenated water only attacks the cellulose when very concentrated. With equal strengths, and immersion for the same time, chlorine has a much more destructive action, and, at the same time, a smaller bleaching power, than oxygenated water. In the same conditions, a solution of hypochlorous acid bleaches better, and alters infinitely less, than chlorine water; it is to some extent, an intermediate term between chlorine water and oxygenated water. Chloride of lime may be employed in three different ways in bleaching—viz., with hydrochloric, with carbonic acid, and simply in contact with the oxidisable matter. Of the three, the latter is the most rational, aud presents most security. With regard to antichlors frequently employed, such as hyposulphite of soda, MM. Fordos and Gélis have demonstrated that if these substances remove, on the one hand, all trace of chlorine, on the other they favour the formation of acids pernicious to the cellulose. M. Kolb proposes to replace them by dilute ammonia, which acts first as antichlor in producing nitrogen and chloride of ammonium, and, further, removes, at the same time, all trace of acid from the tissue.

Certain fibres, perfectly bleached to all appearance, take, after a time, a yellow shade; this is only the case with those which have not been completely deprived of their pectic matters. M. Kolb has found ammonia in this respect a valuable reagent for detecting at once the possibility of this result taking place. All fibres which

have been bleached and rigorously deprived of pectose may be plunged in ammoniacal water with impunity; but if the exhaustion with lyes has not been complete, an amber tint will be immediately communicated.

NOTICES OF BOOKS.

Scientific Blue Books, No. II. Ninth Report of the Medical Officer of the Privy Council, with Appendix. London.

(Concluded from vol. xviii., p. 163).

A LARGE space has already been devoted to our abstract of Dr. Thudicum's original spectroscopic work, which we venture to say could not have been condensed further without serious loss; a summing up of the whole now remains. The reader who has followed the whole attentively, will find how gradually he has been led to a brilliant result in experimental science.

Attention has already been drawn to urocyanine, and its resemblance to indigo spectroscopically; as the interest centres here we will give the special features of its spectrum. The solution taken was 1 centimetre in thickness. Its colour and spectrum remained unchanged by the addition of some sulphuric acid. The intensity was about half saturation (as expressed in a diagram). After the solution had stood at rest for twenty-four hours, some blue matter had been deposited upon the sides of the glass, and the particular spectrum was replaced by an ordinary one. It was thus shown that the urocyanine is soluble in alcohol only in the nascent state, and soon becomes insoluble. Its quantity was so small, that beyond a test with nitric acid, which showed that it was destroyed, leaving some yellow colour, no further reactions could be made with it. Several other specimens of early urine of reaction yielded similar blue and purple matters, which also admitted of the identification of their absorption phenomena with those of the case of M. Willis.

As this same urocyanine has been described by some as indigo, the following conclusions are very valuable :—In the indigo spectrum the blue is, at all events, unaltered, and a blue cast is thrown over yellow and green. The spectrum of urocyanine shows no blue at all; at the end of green the spectrum is cut off; no manipulation, such as those related, can make it appear, no concentration of the indigo solution that allows the band to appear extinguishes the blue part of its spectrum. The proof that these bodies, if both are in a pure state, are not chemically identical, however related, is complete.

The colouring matter of bile has long been known to produce with nitric acid a blue colour among others, and as the reaction of cholera urine had in the Bavarian report been likened to this reaction of bile pigment, the following comparison was made:—An ammoniacal solution of cholephæine ($C_9H_9NO_2$) was treated with concentrated nitric acid until a blue precipitate was formed. This was quickly isolated by filtration, and after washing with water, dissolved in alcohol. It yielded a spectrum resembling that of indigo and also that of urocyanine. Important differences in the spectra, however, showed that indigo-urocyanine and cholocyanine are chemically different. Cholocyanine procured by the action, first of fuming sulphuric acid and subsequently of water upon cholophæine, showed an identity with ordinary cholocyanine. We are compelled to resist the temptation of following with our author the diagnosis of urocyanine from other important organic pigments or their products, but the omission of the note of myochrome as connected with these bodies in cholera patients would be inexcusable. It was found that the choleraic process had not changed the myochrome in its chemical composition; the identity of the spectrum of myochrome, which includes the identity of the chemical constitution of myochrome with that of hemochrome, was anew demonstrated.

The urocyanine of cholera urine is present in such small quantities that we can never hope to obtain insight into its composition and atomic weight by direct analysis; but the information wanted has to be obtained by synthetical comparisons similar to those of our author.

The following instructive list is given, when the ascertained spectra are arranged in the order of their succession from the red end towards the violet :—

Myohemine	..	142° 42′ – 142° 12′ = 0° 30′
Hemine	..	142° 36′ – 142° 6′ = 0° 30′
Urocyanine	..	142° 30′ – 141° 54′ = 0° 36′
Indigo	.. ..	142° 24′ – 141° 48′ = 0° 36′
Urorubine	.. ..	142° 24′ – 141° 54′ = 0° 30′
Hematine	.. ..	142° 18′ – 141° 48′ = 0° 30′
Cholocyanine	..	142° 6′ – 141° 48′ = 0° 18′
Cyanine	.. ..	142° 12′ – 141° 20′ = 0° 42′

The last-named body, a double base, obtained from animal oil, but containing iodine, possesses a spectrum which in several respects resembles the spectra below which it is ranged for the purpose of illustration and comparison. The alcoholic solution has the same purple blue colour as urocyanine, but, unlike this latter, it is easily and rapidly discoloured by acids. Like indigo it has the blue part of the spectrum bright and fully developed, and differs by this peculiarity from urocyanine and the hemochrone products.

"I have compared many more substances with those above mentioned. Organic colouring matters, particularly some from plants, yield spectra much resembling the hæmatic series, *e.g.*, tincture of privet berry, which gives almost the hæmatine spectrum. Inorganic bodies, such as oxalic solution of Prussian blue, yield no separate bands, but peculiar absorptions, particularly of the red end of the spectrum. As these researches fail to throw any further light upon the particular point here enquired into, they cannot be here related."

Since this report was issued, in the *Journal für Practische Chemie* of last July, Dr. Thudicum has made further remarks on the colouring matters of urine and on uromelanine, a decomposition product of urochrome. It is well known to physiologists that every colouring matter in the human economy has at least four or five different names, the *x* chrome of one author may equal the *x* xanthin of another, or the *y* chrome of a third with any number of permutations. If Dr. Thudicum would give to the world his coloured spectroscopic plates and his last researches, retaining his nomenclature, in one volume, the slough of despond would be crossed by a railway, by which all could travel with a chance of finding both termini, not the one of departure only.

We strongly urge, then, the want of an arrangement upon an accurate basis, including the last results of these pigments; if Dr. Thudicum does not care to face such a task, we know of no substitute for him. In default, the medical jurist and the pathologist must feel a debt of gratitude to the Government for this most valuable report afforded for their use.

CORRESPONDENCE.

THE COHESION FIGURES OF LIQUIDS.

To the Editor of the Chemical News.

SIR,—I had the pleasure, last night, at the *soirée* given at King's College, of seeing Professor Woodward work the apparatus (contrived by him and described at p. 21 of your journal) for showing the cohesion figures of liquids on a large scale to an assembly of persons.

The apparatus answered its purpose admirably. It is simple in arrangement and easy to manage. The water surface, 3 inches in diameter, on which the drops are deposited and the figures formed, is quite accessible, and nearly as easy to work with as the water in my shallow

glasses 4 inches in diameter. The heat of the lamp has an effect on the water, and allows the development of figures on the smaller scale which would probably not take place at ordinary temperatures. The screen, 5 feet in diameter, is well filled and the definition good. Some of the figures are a little too faint, owing to the great expansion and the brightness of the light, and for similar reasons, colour, which is so charming a feature in many of the figures, is wanting.

The figures shown on this occasion were those of only a few liquids, viz., creosote, a mixture of equal parts carbolic and cresylic acids, benzol, oil of lavender, and a solution of camphor in benzol. I am satisfied from what I saw that the figures of a large number of liquids might be exhibited with ease and in rapid succession, provided the lecturer was assisted by persons who understood the conditions of the illustrations. I may, perhaps, be pardoned if I state briefly what these are, as success or failure will very much depend on the mode in which these conditions are observed.

The most essential condition in the production of these figures is chemical cleanliness. To insure this, one water recipient (No. 1) (marked B in the figure, page 21, *ante*) ought to be in process of cleaning; a second (No. 2) ought to be clean, and filled with water, while the third (No. 3) is on the point of being removed from the apparatus. Thus there ought to be three water recipients in use.

Next, as to the mode of cleaning. As soon as No. 3 is removed from the apparatus its contents are to be emptied into a waste pan, and clean water poured over it from a jug into the pan. It should then be filled with a moderately strong solution of caustic potash, which is not to be thrown away, but poured into a reserve potash jar. (A quart Phillips's jar with a funnel in the mouth is a convenient receptacle for the potash solution). When the water recipient, No. 3 has thus been washed with potash, it should be again rinsed with water, and, lastly, filled with clean or distilled water from a bottle—not from a washing bottle by means of a blowing tube, but simply from a clean bottle, which is to be kept closed when not in use. In filling No. 3, it may be placed on a clean cloth or flat surface of sponge, so as to dry the flat bottom surface. By this time No. 2 is resting on such a surface ready to be transferred to the apparatus, and No. 1 is in process of cleaning. In this way there need be no delay in producing the figures, and the lecturer will be able to resist the temptation, should a drop fail to spread, of waiting in hopes it will do so, or of trying another liquid on an already impure surface.

Next, as to the method of delivering the drops to the surface of the water. It is commonly supposed that provided the drops reach the surface it does not much matter how. They are generally allowed to fall upon the water. This is quite wrong, and may be a source of frequent failure. A distinct drop should be gently delivered to the centre of the water from the end of a glass rod, with a steady hand and the absence of every kind of disturbance. In this way we get symmetrical figures of great beauty. The glass rods, when not in use, should be kept in a solution of caustic potash. When one is taken out it should be passed through clean water with a brisk stir and then wiped in a clean cloth. It may now be dipped into the oil, &c., and the liquid left to drain, until it is seen that a distinct drop can be fairly delivered. The rod is now to be wiped in a dirty duster (No. 3), then in a moderately clean duster (No. 2), and, lastly, in a clean duster (No. 1) before returning it to the potash solution.

Pipettes and dropping tubes should only be used for ether, alcohol, and those liquids of which the figures have a short duration. A drop being delivered to the water surface, the hand should be removed for a moment, to allow an uninterrupted view on the screen, but the moment one figure has vanished another drop should be deposited on the surface. In this way a perfect idea of the figure will be gained from a succession of optical images.

By a judicious use of the caustic potash solution the apparatus can be kept in good working order; but after using oils for some time the water vessels, glass rods, &c., require to be washed in strong sulphuric acid and well rinsed. The lecturer will soon find out for himself when this is necessary.

Another source of failure in the production of these figures lies in the impurity of the figure-producing liquid. One of the most difficult figures to produce is that of oil of lavender (it was admirably shown by Professor Woodward's apparatus): one reason is that this oil is so commonly adulterated with oil of turpentine; another that the oil becomes partially resinified by age. The figure, produced last night, was from a Mitcham oil about eight years old, re-distilled by me nearly three years ago. I have several specimens of these oils of different ages; they all give good figures, but some foreign oils that I have by me produce nothing but disappointment.

Solid carbolic acid in small fragments, rotates on the water surface with immense velocity, after the manner of camphor. (Camphor also may be tried, but the fragments should be scraped from a freshly cut surface with the point of a pen-knife). If a needle of the commercial acid be placed on the water, it darts about, suddenly liquefies forms into a disc from which angry-looking waving forked tongues proceed, and so it wastes away. If the liquid acid be used, care must be taken to deliver it gently to the surface, or it will slip through and form an inert globule at the bottom of the water.

Carbolic acid, or a mixture of this and cresylic acid, forms an active vigorous figure, and if a drop be placed on the same surface with what is left of the lavender figure, the mutual attractions and repulsions form a surprising sight.

Cresylic acid leaves' delicate silvery flakes on the surface of the water, and in this way the presence of a few drops per cent of this acid in carbolic acid can be detected.

I intended to have given a list of liquids likely to form good figures before an audience, but as this letter is perhaps already too long, I must defer doing so.—I am, &c.,

C. TOMLINSON.

Highgate, N., Jan. 15, 1869.

ON THE ARTIFICIAL FORMATION OF "ATACAMITE."

To the Editor of the Chemical News.

SIR,—In the *Journal of the Chemical Society* for this month, p. 24, Mr. Church, in continuing his mineralogical notices, states that in 1864 he commenced a series of experiments upon the action of salt on "chessylite," whereby he hoped to elucidate the formation of atacamite when sea water acts on copper ores. The author continues "the only really successful experiment was one in which the following substances had been placed together:—200 c.c. of a 10 per cent solution of salt *gave* 2 grammes chessylite."

The word *gave* is doubtless the printer's error. The sentence should read, I imagine, "200 c.c. *upon* 2 grammes chessylite."

Mr. Church further says, "the blue colour of the finely powdered chessylite slowly disappeared, a pale green tint taking its place, while at the same time the saline solution became notably alkaline from the conversion of the sodium chloride into carbonate. In the following table the composition of chessylite, of its chlorinated product, and of atacamite, are compared together:—

	Chessylite.	Chlorinated Product.	Atacamite.
CuO	69·2	59·55	53·6
CO_2	25·6	—	—
H_2O	5·2	18·14	16·2
Cu	—	10·47	14·3
Cl	—	11·70	16·0

This experiment recalls some researches of my own made as far back as September, 1858, and published in the *Chemical Gazette*, vol. xvi., p. 430, wherein it is stated that the oxide of copper mechanically brought over by the draft from the calcining furnaces into a culvert running along the shore of the Pacific Ocean, the floor of which was composed of sandy rock through which the sea water permeated, became, after some months, entirely converted into the sulphates and oxychlorides of the metal. After separation of the former, the oxychloride was found to have the following composition :—

Cu	56·92
Cl	16·30
HO	16·14

or—

CuO	53·11
CuCl	30·73
HO	16·14

leading to the formula, $3CuO,CuCl + 4HO$. Native atacamite gives—

Cu	57·13
Cl	16·07
HO	16·07

More than 8 tons of atacamite were thus obtained.—I am, &c.,

Frederick Field, F.R.S.

HOUSEHOLD POISONING: THE TINNING OF SAUCEPANS.

To the Editor of the Chemical News.

Sir,—In connection with the extract inserted in the Chemical News of the 11th ult., on "The Tinning of Saucepans," I hope you will consider the following worthy of space in your valuable columns :—

For some few months my wife, children, and self suffered exceedingly from pains in the stomach and bowels, accompanied by diarrhœa. A sustained contest was kept up between medicine and illness, in which the latter was certainly becoming victorious. Ultimately, on account of defeat, my wife's medical attendant stated substantially that her symptoms were peculiar and unaccountable. This assertion excited my suspicion that her sufferings resulted from poisoning. Being most fortunately a chemist, I at once secured what were at at hand to test for poisons; they were—1 pint of toast water, about 1 pint of tea (the remains of my own breakfast), and a pint of drinking water. The three fluids I mixed, strained, tested carefully, and analysed; and, I may add, was horrified, as well as gratified, to find an enormous quantity, comparatively speaking, of both copper and lead. Eliminative remedies were promptly administered. For two days my wife continued to progress slowly; the morning of the third day from the detection of the causes of her illness she strongly perceived a disgusting metallic or coppery taste, her gums were discoloured and painful, and she sank into a state of collapse, in which apparently hopeless condition she remained for three and a half hours. To the credit, however, of medical skill as a means, she was rallied, has continued to progress, and is now almost wholly recovered. Previous to sinking into this state, she had vomited nearly half a wine-glassful of a beautiful bright saffron-coloured fluid, which I kept, and in which I found a notable quantity of copper and lead, as well as a remarkable proportion of iron and magnesium phosphate; the iron was derived from the mains through which the water is supplied and the cooking utensils, and the magnesium phosphate from toast-water.

Now with regard to the tinning of saucepans; these, I regret to say, are not the only tinned cooking utensils. Here in the north of England, and, I believe, throughout the United Kingdom, there is nothing more common in an ironmonger's shop than pots, pans, kettles, &c., lined with this beautiful but dangerous metal. I know doctors do not generally condemn it as such; I must, however, respectfully differ from them. I presume their reason for permitting its use is the fact of air and water but slowly acting upon it at ordinary temperatures; boiling, stewing, and roasting, however, are not ordinary temperatures—nor are the fluids heated therein, as a rule, free from acids. Moreover, through negligence or ignorance, cooks partially fill vessels lined with this substance, and place them on fires which speedily evaporate or boil down the contents. The flames now wrap the vessels, elevating the temperature of the exposed tin, whereby it is rapidly oxidised. If not oxidised thus quickly, it is soon dissolved by the liquors with which it is heated. When tin is received into the stomach it at once comes into contact with the gastric juice, which contains free hydrochloric acid, with which it combines, forming a most irritant poison.

Another most serious objection to the use of tinned vessels is the admixture of lead mentioned in the extract above referred to. About two months since, when investigating the cause of my family's sufferings, I found in my house a small tinned pan; the tinning of this vessel yielded on analysis over 18 per cent of lead. Nearly the whole of the tin had disappeared from the sides; two small lumps of alloy of it and lead remained at the bottom. I have since examined several tinned pots, &c., which had been in use for twelve months, and found them in an almost identical condition; they caused a great deal of illness, and had to be rejected. The fact of tin being almost completely removed from the sides is a practical proof, if such be necessary, of the oxidation and solution before mentioned. Now I submit that copper, brass, and tinned vessels for the preparation of food can and ought to be discarded. Those made of iron, or iron porcelain-lined, would be uninjurious and excellent substitutes. There are at present many victims to diseases the cause of which they are completely ignorant of, but which could be truthfully charged to brass, copper, and tin. Doctors are defeated and discouraged, and numbers die annually whose lives might be saved by the disuse of poisonous metals for domestic purposes. If chemists of repute or status would bring this serious subject somewhat prominently before medical gentlemen, the latter would not be slow to adopt valuable suggestions, and their instructions to patients, without the aid of law (as in France and Prussia), would compel manufacturers to desist from producing articles for which there would be no demand. I trust the gravity of the subject will be a sufficient plea for asking you to insert this rather lengthy letter.—I am, &c.,

J. C. Lee.

MISCELLANEOUS.

American Institute.—The following lectures are in course of delivery at the American Institute :—

Dec. 30, 1868.—Mr. James Hall, State Geologist, Albany; "On the Evolution of the North American Continent."

Jan. 6, 1869.—Prof. Horsford, Cambridge, Mass.; "On the Philosophy of the Oven."

Jan. 13.—Dr. T. Sterry Hunt, Montreal, Canada; "On Primeval Chemistry."

Jan. 22.—Prof. Doremus, College of the City of New York; "On the Photometer."

Jan. 27.—Mr. Waterhouse Hawkins, of London; "On Comparative Zoology."

Feb. 3.—Prof. Cooke, Harvard College, Mass.; "On the Spectroscope."

Feb. 10.—W. J. McAlpine, Pres. Am. Soc. of C. E.; "On Modern Engineering."

Reports of those lectures most interesting to our readers will appear in our columns.

The Solar Protuberances.—M. Janssen has forwarded a letter from Simla (Himalaya) to the French Academy of Sciences in which, after giving further particulars respecting his discovery of the visibility of the spectra of the protuberances in full sunshine, he describes an ingenious plan by which he expects to be able to see the actual protuberances themselves at any time. The principle consists in getting one of the luminous lines in the spectral field, and then rapidly rotating the spectroscope. As the length of the luminous line depends upon the height of that part of the protuberance which it represents, it is evident that the rotation will cause the line to vary with the different widths of the protuberance, and if the rotation is sufficiently rapid, the permanence of the impression on the retina will produce an accurate representation of the protuberance under examination.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News.")

Comptes Rendus.

October 26, 1868.

J. JAMIN, "On a Differential Refractor for Polarised Light. A. GIRARD, "On a New Volatile and Saccharine Principle Discovered in Caoutchouc from the Gaboon." A. BECHAMP, "On the Decomposition of the Sulphides of the Alkalies and Alkaline Earths by Solution in a Large Quantity of Water." WARREN DE LA RUE, "On the Method employed by J. N. Lockyer for obtaining Spectra of the Protuberances observed during Total Eclipses of the Sun." JANSSEN, "Note on some Results of the Author's Observations of the Total Eclipse of the Sun of August, 18, 1868, at Guntoor, India." FAYE, "Note *à propos* of the Two preceding Papers." BERTHELOT, "On the Formation of Homologues of Benzine by the Reciprocal Action of Free Hydrocarbons of more simple Structure. On the Carbonaceous Matter contained in certain Meteorites."

November 2, 1868.

DELAUNAY, "On the Discovery of a Method of Observing Solar Protuberances at all times." E. PELIGOT, "On the Composition of the Chromites of Iron." S. MEUNIER, "Analysis of a Meteorite." C. MARIGNAC, "On the Latent Heat of Volatilisation of Sal-Ammoniac." F. JOLYET and A CAHOURS, "Researches on the Physiological Action of Methyl-Strychnine and Ethyl-Strychnine." C. GLASER, "On Acetenyl-benzine, a new Hydrocarbon of the Aromatic Series." S. DE LUCA, "Chemical and Therapeutical Researches on the Waters of the Solfatara of Pouzzales." E. GILLES, "A Method of Classifying the Elements based upon their Chemical Equivalents."

Bullatin de l'Académie Imperiale des Sciences de St. Petersbourg.

August 12, 1868.

F. BEILSTEIN and A. KUHLBERG, "On Substituted Alcohols and Aldehydes." E. NEUHOF, "On some Derivatives of Para-Chlorbenzylic Alcohol." J. FRITZSCHE, "Researches on Hydrocarbons." N. ZININ, "On a Product of the Action of Hydrochloric Acid on Essence of Bitter Almonds containing Hydrocyanic Acid.

Annalen der Chemie und Pharmacie.

October, 1868.

R. FITTIG and J. VELGUTH, "Researches on Mesitylene. Fifth Memoir: On Isoxylol, a new Hydrocarbon Isomeric with Xylol." L. BARTH, "Researches on Oxybenzoic Acid. Note on a Compound of Phenol with Carbonic Acid." L. CARIUS, "A new Synthesis of the Aromatic Acids." A. STRECCER, "On Lecithine. On a new Mode of Formation and on the Constitution of Sulpho-Acids." K. BENDER, "On a new Mode of Formation of Sulpho-Ethylic and Disulpho-Ethylenic Acids." A. COLLMAN, "On a new Mode of Formation of Sulpho-Methylic, Isethionic, and Sulpho-Acetic Acids." A. SCHAUFFELEN, "On the Sulpho-Acids of Glycerine." L. DARMSTADTER, "On the relative Constitution and on some Metamorphoses of Epichlorhydrin."

Monatsbericht der Königlich Preussischen Akademie der Wissenschaften zu Berlin.

July, 1868.

E. WIEDEMANN, "On the Magnetism of Chemical Compounds." A. W. HOFMANN, "Contributions to the Knowledge of Guanidine. Compounds Isomeric with the Sulphocyanic Ethers.—II. Homologues and Analogous of Ethylic Mustard Oil."

Journal für Praktische Chemie.

October 17, 1868.

G. WERTHER, "An Analysis of the Meteorite which fell at Pultusk, Russian Poland, on the 30th of January, 1868." J. LOWE, "On the Preparation and Composition of Catechuic Acid."

MEETINGS FOR THE WEEK.

MONDAY, 25th.—Medical, 8.
—— London Institution, 6.
TUESDAY, 26th.—Royal Institution, 3. Mr. Westmacott, "On Fine Art."
WEDNESDAY, 27th—Geological, 8.
—— Society of Arts, 8.
THURSDAY, 28th.—Royal Institution, 3. Prof. Rupert Jones, "On Entozoa."
—— Royal, 8½.
—— Zoological, 8½.
FRIDAY, 29th.—Royal Institution, 8. Mr. Ruskin, "On the Flamboyant Architecture of the Valley of the Somme.
SATURDAY, 30th.—Royal Institution, 3. Dr. Odling, F.R.S., "On Hydrogen and its Analogues."

NOTES AND QUERIES.

Ice House.—Will any person acquainted with the subject, kindly furnish me with a description as to the best method of constructing an ice house on a small scale?—ZERO.

Dynamite.—Your correspondent, Mr. Wheeler, will perhaps be glad to learn that dynamite may be obtained from Messrs. Webb and Co., Carnarvon, N. Wales, the sole consignees in England from the patentee and manufacturer.—ALPHA.

Separating Iron and Brass Dust.—We wish to know the name and address of the patentee (or the maker) of an electro-magnetic apparatus for separating iron from brass dust. The name of any firm using one will answer our purpose as well, as we wish to make enquiries as to the capabilities of the apparatus.—HIBBERT & Co.

TO CORRESPONDENTS.

*** VOL. XVIII. of THE CHEMICAL NEWS, containing a copious index, is now ready, price 11*s.*, by post, 11*s.* 6*d.*, handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1*s.* 6*d.* Subscribers may have their copies bound for 2*s.* 6*d.* if sent to our office, or, if accompanied by a cloth case, for 1*s.* Subscribers wishing to complete their sets of volumes, are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xix. commenced on January 1st, and will be complete in twenty-six numbers. It will contain a verbatim report of Dr. Odling's Juvenile Lectures at the Royal Institution "On the Chemical Changes of Carbon," and original papers from some of our leading English and Foreign Chemists and Physicists.

C. R.—To ascertain the composition of the substance forwarded to us would involve a chemical analysis.

S.—1. Apply to Messrs. Johnson and Matthey. 2. Consult O'Neill's "Dictionary of Calico Printing."

Per Marc Per Terram.—An "assay centner" is an indefinite technical term. It means 100 units of weight. In copper assays, for instance, the centner is frequently 400 grains.

T. Thompson.—Phosphate of lime is decomposed by ebullition with an aqueous solution of oxalic acid. Probably this reaction will be of use in your research.

A. M. Edwards.—1. The presence of alkali prevents iron from rusting, and this fact is frequently made use of, but we have not seen any satisfactory explanation of the circumstance. 2. Thallium and its salts can be procured from Messrs. Hopkin and Williams, New Cavendish Street, London, W. 3. There is only one copy of vol. ix. at our office; its price is 30*s.*

G. F. R., and others.—It is gratifying to know that the alteration of type which we have introduced with Dr. Odling's Lectures gives such satisfaction. The fount, which has been specially cast for us, is particularly legible, retaining all the picturesque quaintness of antique style with the mathematical accuracy which characterises modern type.

Communications have been received from Professor Wanklyn; R. Mallet, F.R.S.; W. T. Suffolk; E. Stanton; Professor A. M. Edwards, New York; W. Little; Hibbert and Co.; E. P. H. Vaughan; J. Salter; J. Spiller; M. L'Abbé A. Hamy; G. Keyworth; E. Pocknell; Messrs. Townsend and Adams; E. W. Ball; J. F. Dickson; C. K. Jewett, Göttingen (with enclosure); B. Sulman; J. J. Ward; Rivington and Co. (with enclosure); A. F. Francis; Dr. Wallace (with enclosure); J. Solomon; B. Nickels; Gaskell, Deacon, and Co.; G. F. Rodwell; J. Hughes; T. Ludwig, Suez, Egypt; W. M. Watts; Professor Rudolph Fittig (with enclosure); and Dr. S. Muspratt.

BOOKS RECEIVED.

The Photographic Journal, No. 201, vol. 13.
Report of Annual Meeting of Members of the Lincolnshire Farmers' Association.
Van Nostrand's Eclectic Engineering Magazine, No. 1 vol. 2.

THE CHEMICAL NEWS.

Vol. XIX. No. 478.

ON THE CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(Adapted to a Juvenile Auditory),

delivered at the

ROYAL INSTITUTION OF GREAT BRITAIN,

(CHRISTMAS, 1868-9),

by

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE III.

Air—Oxides—Carbon or Charcoal.

Unabsorbed four-fifths of original air known as phlogistic air, or nitrogen; its capability of supporting combustion and life—Recovery of absorbed one-fifth of air, by heating the rust of mercury—Proportion of ordinary air absorbed by rusting mercury, and evolved by ignition of the rust, known as vital air, or oxygen; its extreme power of supporting combustion and life—Reproduction of ordinary air by admixture of vital air, or oxygen, with phlogistic air, or nitrogen—Formation of oxides by combustions of different substances in air or oxygen—Formation of arsenious acid or oxide, by combustion of arsenic; of carbonic acid or oxide, by combustion of carbon; of sodium oxide or soda, by combustion of sodium—Oxidation of carbon by its ignition with arsenious acid, and correlative deoxidation of the arsenic—Oxidation of sodium by its ignition in carbonic acid gas with correlative deoxidation of carbon or charcoal—Existence of carbon, or charcoal, in burnt or oxidised, and in unburnt or unoxidised condition—Presence of charcoal in any combustible shown by occurrence of carbonic gas, or oxide of carbon, as a product of its burning—Presence of hydrogen in any combustible shown by occurrence of water, or oxide of hydrogen, as a product of its burning—Presence of both carbon and hydrogen in coal-gas shown by occurrence of both carbonic gas and water as products of its burning—With deficient supply of air, preferential burning of the hydrogen of coal-gas, and partial separation of its carbon—Separation, also, of the carbon of coal-gas as a result of its ignition, or simple exposure to a red heat—Ordinary production of charcoal from wood, peat, &c., by the processes of partial burning and of ignition respectively—Unburnt carbon the characteristic constituent of vegetable tissue—Passage of unburnt charcoal from the vegetable into the animal and mineral kingdoms—Manufacture of animal charcoal, or bone-black, and of mineral charcoal or coke—Remarkable porosity of certain kinds of charcoal—Extraction from boxwood charcoal of many times its volume of air; absorption by boxwood charcoal of fifty-five times its volume of sulphuretted hydrogen gas, and ninety times its volume of ammonia gas; yet greater absorptive power of cocoa-nut shell charcoal—Chemical reactions on each other of different gases absorbed into charcoal—Absorption and aërial oxidation of putrefactive vapours by charcoal—Principle of charcoal ventilators, charcoal respirators, &c.—Absorptions of different colouring and odourous matters from solution by charcoal—Purification of water by charcoal filters, with destruction as well as absorption of impurities.

You will remember that when charcoal or carbon burns in air it is changed into carbonic gas; we have now to consider what is the nature of this change—what it is that happens to the charcoal, and what it is that happens to the air in which the charcoal burns.

In order to find out what occurs to the air we must first know a little more about the air, and particularly whether ordinary air, in which the combustion of charcoal and other combustibles takes place, consists of one kind of air only, or is a mixture of two or more different kinds. You will remember that all kinds of air are miscible with each other; in this respect, they differ from liquids, and accordingly we have this morning to begin our consideration of the question whether air consists of one kind of air only or of two or more different kinds. But first I want to direct your attention for a moment or two to an experiment which, as it takes some little time, I will now commence, and in half an hour we shall, perhaps, see the result.

Here I have an ordinary transparent glass tube, which is filled with pieces of broken white porcelain, and through this tube I am going to pass a current of ordinary coal gas. The coal gas is now passing through the tube; we will just let it blow out the air with which the tube was first filled, and then we will apply a light to it. Now you observe that the tube is filled, and that the gas burns in the ordinary way in which coal gas burns; gas is passing through the porcelain, but it does not now produce any effect. I am going to repeat this experiment with this difference—that the tube instead of being cold will be made red hot, and after the porcelain has been heated sometime in the furnace we shall see whether it has undergone any change. [Near the close of the discourse, the lecturer again drew attention to this experiment, and pointed out that, under the influence of the strong heat which had been applied to the tube, the coal gas had deposited a portion of its carbon; the separation of the carbon being evidenced by the blackening of the porcelain.]

We will now proceed to the consideration of the nature of ordinary atmospheric air.

When a body—iron wire, for instance—rusts in the air, this is the sort of thing that occurs. If you take five measures of air, and put the iron wire into them, they grow gradually less and less in bulk; a portion of the air becomes ab-

* Reported verbatim, by permission of the Author, for this Journal.

sorbed by the iron wire until a certain point is reached when exactly one-fifth of the entire quantity of air has been absorbed, and when this has taken place, the rusting action ceases. The absorption goes on no longer, but the remaining four measures of air are of a very different character from the original five; metals will no longer rust in them, bodies will no longer burn in them, and animals will no longer breathe in them. Apparently, therefore, the whole of the gas which enables metals to rust, combustibles to burn, and animals to breathe, exists in the one-fifth of the volume of air taken up by the rusting wire.

Now let us pass to the burning of a body. If we burn, in a confined volume of air, some highly combustible substance, such as phosphorus or sulphur, the same thing takes place. The phosphorus goes on burning, and as it burns the volume of air gets less and less, until exactly one-fifth part of it has disappeared, and as soon as one-fifth is consumed the phosphorus is extinguished; it no longer burns, and we get exactly the same kind of air as in the other case. Of our original five volumes of air, we have four remaining, and in these, metals will no longer rust, combustibles will no longer burn, and animals will no longer breathe. If, instead of burning a highly combustible body like phosphorus, we take one less so, such as a candle, we find that it is extinguished before one-fifth part of the air has been taken up; but if we then introduce some iron wire it will rust and take up a further portion of the air, and when the iron wire no longer rusts in it we shall find that the quantity of air taken up by the candle, supplemented by the remaining portion taken up by the rusting of the wire, amounts to exactly a fifth part of the original volume. Again, if we put a bird or a mouse into a vessel of air, it would go on breathing whilst our air became less and less, but it could not go on until it had entirely taken up the fifth part of the original air. These animals are, in this respect, in the condition of the candle; but if we take some slow breathing animals, such as snails or frogs, and put them into a confined quantity of air, they will do exactly what the burning phosphorus does—they will go on breathing until they have consumed the fifth part of the volume of the original air, and they will leave four volumes of air of the same character as that left by the burning phosphorus, in which metals will no longer rust, combustibles will no longer burn, and animals will no longer breathe.

Now comes the question—what is the nature of these remaining four volumes of air? Chemical experiments tend to prove that they are of the sort to which the Greek name of *azotic* or lifeless air was given. It was also called by another name, equally long, and far more barbarous—*phlogistic* air. It has also received the name of *nitrogen* gas, by which it is generally known. Here is a bottle of nitrogen; we introduce into it a lighted taper, and it is immediately extinguished.

Now is it possible to recover this one-fifth part of the air which has been absorbed? Yes, it is; and it is interesting to note that the particular experiment by which the composition of air was first ascertained by Lavoisier is the same which still best serves to exemplify its composition. I have spoken to you about the rust of iron. Chemists are acquainted with a great number of metals, and in particular with that metal which you see in this bulb, and which you know as quicksilver or mercury. It is a very peculiar metal, and the only one which is in a liquid state at the ordinary temperature. You know that lead, for instance, is solid at the ordinary temperature, but it will become liquid upon being heated, and even iron and gold when very intensely heated also become liquid. Mercury, however, is hot enough at common temperatures to exist in the liquid state, and it is the only metal with which chemists are acquainted that is so. At the ordinary temperature, whether in summer or winter, and in any climate, mercury does not rust. It only rusts when heated, and then it does so very quickly, and meanwhile maintains just the same sort of action as the iron does. As it rusts it absorbs one measure out of the five measures of air, and we obtain, as the result, a quantity of the rust of mercury, which is a red substance not unlike the rust of iron. This bottle contains some of it; it was made by rusting mercury in heated air.

There is another point of interest in connection with this rust—if you go on heating it still more strongly the mercury which had become converted into rust, makes its appearance again in the original state, and at the same time a quantity of air or gas is given off, the peculiarity of which is that the amount of gas so evolved is exactly the quantity of air or gas which the mercury absorbed in rusting; so that if you take five measures of air and heat the mercury in them, and so absorb one measure, and then take the rust of mercury so produced and re-heat it, you recover exactly the one measure of air which the mercury originally absorbed. Here is the experiment arranged in this small tube. We have in the tube some of the rust of mercury. We will heat it rather strongly, and in the course of a little while we shall find that it will break up into the original mercury, and into a certain quantity of air or gas, which, in a few minutes, we will collect in this receiver, in order to ascertain its nature. This substance will take some little time in becoming sufficiently hot, because, after it is heated to the temperature at which mercury

rusts, it must be heated to a degree beyond, that it may undergo this decomposition into the original mercury and into the gas. [After an interval]—Our decomposition has taken place in the tube. The vital air is now being given off by the action of heat, and in the upper part of the tube we have the mercury in a separated state. I will just show you what is the nature of the air which we have in our tube—even this small quantity will suffice for our purpose. We introduce a match into this vessel, and you see how very brilliantly it will burn in the vital air from the rust of mercury.

We will now consider what are the properties of this particular kind of air; it has *this* property—that if you take the one measure of air which the mercury first absorbed in order to rust, and add it to the four volumes of air that remain, you get exactly the quantity with which you started—viz., five volumes; and more than that, these five volumes so formed are undistinguishable, by any means whatever, from the original air with which you began the experiment. Now you will remember that this nitrogen—this residual air—is a kind in which bodies will not rust, nor combustibles burn, nor animals breathe. The breathing capabilities all lie in the one-fifth part which becomes absorbed. Then comes the question, what name shall we give to this one volume upon which the breathing power of animals is exercised? It was originally called *vital air*—and formerly all these different kinds of gases were called *airs*; this *vital air* is now known as *oxygen gas*.

Now, from what we have observed in the experiments which have been explained to you, we learn that atmospheric air is a mixture of four volumes of phlogistic air, or nitrogen, with one volume of vital air or oxygen; at any rate, this may be taken as about the proportion between the two. It is not exactly correct; the actual figures are—79 parts (instead of 80) of nitrogen, and 21 parts (instead of 20) of oxygen, to make up 100 parts of ordinary atmospheric air; this, then, is the composition of the atmosphere.

I will now proceed to direct your attention to some of the properties of oxygen. You will remember that in my former lecture I called to your minds the fact that, in addition to ordinary combustibles, such as candles, coals, and gas, chemists are in the habit of regarding different metals as combustible bodies; and I showed you how magnesium and zinc might be burnt in air. Now I wish first to direct your attention to the manner in which iron may be burnt in air, and then to the way in which it may be burnt in oxygen.

We will first burn some iron in air, and for that purpose we must employ a current of air, and also have our iron in a very fine state of division—viz., in filings; for you know that iron in a large mass, such as a poker, will not burn in air, but in the state of filings, you will see that it will do so, and with very considerable brilliancy. [Steel filings were showered upon a large flame from a gas blowpipe, and burned with their well-known star-like effect.] You see that in this way iron may very readily be burnt in ordinary air. Now I want to call your attention to the very different manner in which it burns in oxygen gas. When we burnt it in the air it was in the form of filings, but we can burn it in oxygen in a much larger mass. We take just such a flame as we had in the last experiment; but, instead of it being supplied with a current of air, as the other was, it is supplied with a current of oxygen gas, and in this we will now try to burn a piece of iron. For this purpose, we will take an old knife, and see what will happen. [A portion of the knife-blade was speedily consumed in the flame, and the combustion was attended by copious scintillations.] Well, you see it is very fortunate (if the expression is a correct one in such a case) that our atmosphere does not consist entirely of oxygen; for if once these knives got thus heated they would burn almost entirely away, and we should have none for use. So much, then, for the manner in which bodies burn in oxygen gas compared with the way in which they burn in ordinary air.

We will now endeavour to burn another metal in oxygen, and it is one with which you are not quite so familiar. There is a piece of metal in this tube; we apply heat to the tube, and the metal will very soon be hot; you will then see it burn in the oxygen gas which we now pass through the tube. We will have the lights lowered that you may see the very beautiful appearance it presents when burnt under these circumstances. It is just beginning to take fire, and now you see it burning with great brilliancy. The metal upon which we are now experimenting is arsenic, and by burning it we have produced a compound of the metal with the oxygen in which it burned, and this compound is oxide of arsenic, or the ordinary white arsenic of the shops. Now, having burnt this substance—arsenic—we are next going to do the same with charcoal. We have some in this dish, and the first thing we must do is to ignite it. You remember that when charcoal burns in oxygen it forms carbonic gas, and this carbonic gas is an oxide of carbon, just as the white arsenic which we formed by burning arsenic in oxygen was an oxide of arsenic.

Now, if instead of burning the charcoal in oxygen, we burn it in the white arsenic, the oxygen, under those circumstances, would leave

the arsenic in order to burn the charcoal. The charcoal is burnt into carbonic gas, and the white arsenic is correspondingly unburnt into metallic arsenic. Here is the experiment already performed. We had here a mixture of white arsenic and charcoal; the charcoal took away the oxygen from the arsenic, and burned in that oxygen, consequently the arsenic is deposited in a metallic state in the form of this black ring.

I will now show you the combustion of one other metal in oxygen—sodium—and while it is burning I will again have the gas-lights lowered, and ask you to look at the appearance which the various colours upon this diagram exhibit when they are illuminated by the sodium light; and now compare the appearance of those colours under the sodium light with their present aspect in the bright light afforded by the burning of the metal magnesium. Now, when the sodium burns in oxygen it forms soda, or oxide of sodium. What then takes place with the sodium, when instead of burning in pure oxygen, it burns in carbonic gas? Just what I showed you in the first lecture. It burns in the oxygen which is already combined with the carbon; it takes away the oxygen from the carbon, in this way setting it free, just as when the charcoal burnt in the oxide of arsenic it took away the oxygen of the oxide of arsenic, and set free the arsenic in the metallic state.

(To be continued).

Researches on Trimethylbenzine.—This product is obtained by synthesis from xylene and toluine, and the substitution and oxidation products of this compound have been examined. In the same research the presence of mesitylene in mineral pitch, and its production, by the action of liquid chloride of zinc on camphor, is shown.—*Nouv. de Gœttingue.*

A New Ventilator.—M. Damboise-Bénard has designed and patented an apparatus for increasing the draught in chimneys, and promoting ventilation. The apparatus consists of a hood, which is placed on the top of the chimney; this hood is movable—that is to say, it rotates upon an axis. In the centre of the hood a narrow tube is fixed vertically; the top of this tube is curved laterally and furnished with a funnel, and after descending a considerable distance into the chimney, it ends in a slightly upward curve. The outer moving portion first mentioned contains numerous lateral openings, protected by wedge-shaped hoods, which prevent ingress of air; there are also four other openings at the top, constructed so as to facilitate egress of air. At the back of the funnel a square piece of metal sheet is attached, to act as a sail. It is scarcely necessary to point out how this apparatus works; the current of fresh air enters the funnel, is obliged to traverse the narrow tube, and creates a current by which smoke and vitiated air are driven out through the openings in the hood. The central narrow tube serves, besides the purposes already described, to balance the hood. According to size, the price of the apparatus is forty, fifty, or sixty francs; the address of the inventor is Rue de Lille, 31, Boulogne-sur-Mer. We understand that this invention is well spoken of by the highest authorities, and is in use in many of the hospitals, bathing establishments, &c., in Paris, Boulogne, and other places.

ON THE

RELATION OF HYDROGEN TO PALLADIUM.*

By THOMAS GRAHAM, F.R.S., Master of the Mint.

It has often been maintained on chemical grounds that hydrogen gas is the vapour of a highly volatile metal. The idea forces itself upon the mind that palladium with its occluded hydrogen is simply an alloy of this volatile metal in which the volatility of the one element is restrained by its union with the other, and which owes its metallic aspect equally to both constituents. How far such a view is borne out by the properties of the compound substance in question will appear by the following examination of the properties of what, assuming its metallic character, would fairly be named hydrogenium.

Density.—The density of palladium when charged with 800 or 900 times its volume of hydrogen gas is perceptibly lowered, but the change cannot be measured accurately by the ordinary method of immersion in water, owing to a continuous evolution of minute hydrogen bubbles which appears to be determined by contact with the liquid. However, the linear dimensions of the charged palladium are altered so considerably that the difference admits of easy measurement, and furnishes the required density by calculation. Palladium in the form of wire is readily charged with hydrogen by evolving that gas upon the surface of the metal in a galvanometer containing dilute sulphuric acid, as usual.† The length of the wire before and after a charge is found by stretching it on both occasions by the same moderate weight, such as will not produce permanent distention, over the surface of a flat graduated measure. The measure was graduated to hundredths of an inch, and by means of a vernier, the divisions could be read to thousandths. The distance between two fine cross lines marked upon the surface of the wire near each of its extremities was observed.

Expt. 1.—The wire had been drawn from welded palladium, and was hard and elastic. The diameter of the wire was 0·462 millimetre; its specific gravity was 12·38, as determined with care. The wire was twisted into a loop at each end, and the mark made near each loop. The loops were varnished so as to limit absorption of gas by the wire to the measured length between the two marks. To straighten the wire, one loop was fixed, and the other connected with a string passing over a pulley and loaded with 1·5 kilogramme, a weight sufficient to straighten the wire without occasioning any undue strain. The wire was charged with hydrogen by making it the negative electrode of a small Bunsen's battery consisting of two cells, each of half a litre in capacity. The positive electrode was a thick platinum wire placed side by side with the palladium wire, and extending the whole length of the latter, within a tall jar filled with dilute sulphuric acid. The palladium wire had, in consequence, hydrogen carried to its surface for a period of one and a half hour. A longer exposure was found not to add sensibly to the charge of hydrogen acquired by the wire. The wire was again measured and the increase in length noted. Finally, the wire being dried with a cloth, was divided at the marks, and the charged portion heated in a long narrow glass tube kept vacuous by a Sprengel aspirator. The whole occluded hydrogen was thus collected and measured; its volume is reduced by calculation to Bar. 760 m.m., and Therm. 0° C.

The original length of the palladium wire exposed was 609·144 m.m. (23·982 inches), and its weight 1·6832 grm. The wire received a charge of hydrogen amounting to 936 times its volume, measuring 128 c.c., and therefore weighing 0·01147 grm. When the gas was ultimately expelled, the loss as ascertained by direct weighing was 0·01164 grm. The charged wire measured 618·923 m.m., showing an increase in length of 9·779 m.m. (0·385 inch). The increase in linear dimensions is from 100 to 101·605; and

* Read before the Royal Society, January 14th, 1869.

† *Proceedings of the Royal Society*, p. 422, 1868.

in cubic capacity, assuming the expansion to be equal in all directions, from 100 to 104·908. Supposing the two metals united without any change of volume, the alloy may therefore be said to be composed of—

	By volume.		
Palladium	100	or	95·32
Hydrogenium	4·908	or	4·68
	104·908		100

The expansion which the palladium undergoes appears enormous if viewed as a change of bulk in the metal only, due to any conceivable physical force, amounting as it does to sixteen times the dilatation of palladium when heated from 0° to 100° C. The density of the charged wire is reduced by calculation from 12·3 to 11·79. Again, as 100 is to 4·91, so the volume of the palladium, 0·1358 c.c. is to the volume of the hydrogenium 0·006714 c.c. Finally, dividing the weight of the hydrogenium, 0·01147 grm. by its volume in the alloy, 0·006714 c.c. we find

Density of hydrogenium .. .. 1·708

The density of hydrogenium, then, appears to approach that of magnesium, 1·743, by this first experiment.

Further, the expulsion of hydrogen from the wire, however caused, is attended with an extraordinary contraction of the latter. On expelling the hydrogen by a moderate heat, the wire not only receded to its original length, but fell as much below that zero as it had previously risen above it. The palladium wire first measuring 609·144 m.m., and which increased 9·77 m.m., was ultimately reduced to 599·444 m.m., and contracted 9·7 m.m. The wire is permanently shortened. The density of the palladium did not increase, but fell slightly at the same time, namely from 12·38 to 12·12; proving that this contraction of the wire is in length only. The result is the converse of extension by wire-drawing. The retraction of the wire is possibly due to an effect of wire-drawing in leaving the particles of metal in a state of unequal tension, a tension which is excessive in the direction of the length of the wire. The metallic particles would seem to become mobile, and to right themselves in proportion as the hydrogen escapes; and the wire contracts in length, expanding, as appears by its final density, in other directions at the same time.

A wire so charged with hydrogen, if rubbed with the powder of magnesia (to make the flame luminous), burns like a waxed thread when ignited in the flame of a lamp.

Expt. 2.—Another portion of the same palladium wire was charged with hydrogen in a similar manner. The results observed were as follows:—

Length of palladium wire	488·976 m.m.
The same with 867·15 volumes of occluded gas	495·656 ,,
Linear elongation	6·68 ,,
Linear elongation on 100	1·3663 ,,
Cubic expansion on 100	4·154 ,,
Weight of palladium wire	1·0667 grm.
Volume of palladium wire	0·08072 c.c.
Volume of occluded hydrogen gas ..	75·2 ,,
Weight of same	0·00684 grm.
Volume of hydrogenium	0·003601 c.c.

From these results is calculated—

Density of hydrogenium .. .. .. 1·898.

Expt. 3.—The palladium wire was new, and on this occasion was well annealed before being charged with hydrogen. The wire was exposed at the negative for two hours, when it had ceased to elongate.

Length of palladium wire	556·185 m.m.
Same with 888·303 volumes hydrogen	563·632 ,,
Linear elongation	7·467 ,,
Linear elongation on 100	1·324 ,,
Cubic expansion on 100	4·025 ,,
Weight of palladium wire	1·1675 grm.
Volume of palladium wire	0·0949 c.c.
Volume of occluded hydrogen gas ..	84·3 ,,
Weight of same	0·007553 grm.
Volume of hydrogenium	0·003820 c.c.

These results give by calculation—

Density of hydrogenium .. .. .. 1·977

It was necessary to assume in this discussion that the two metals do not contract nor expand, but remain of their proper volume on uniting. Dr. Matthiessen has shown that in the formation of alloys generally the metals retain approximately their original densities.*

In the first experiment already described, probably the maximum absorption of gas by wire, amounting to 935·67 volumes, is attained. The palladium may be charged with any smaller proportion of hydrogen by shortening the time of exposure to the gas (329 volumes of hydrogen were taken up in twenty minutes), and an opportunity be gained of observing if the density of the hydrogenium remains constant, or if it varies with the proportion in which hydrogen enters the alloy. In the following statement, which includes the three experiments already reported, the essential points only are produced:—

TABLE.

Volumes of Hydrogen occluded.	Linear expansion in millimetres. From	To	Density of Hydrogenium.
329	496·189	498·552	2·055
462	493·040	496·520	1·930
487	370·358	373·126	1·927
745	305·538	511·303	1·917
867	488·976	495·656	1·898
888	556·185	563·652	1·977
936	609·144	618·923	1·708

If the first and last experiments only are compared it would appear that the hydrogenium becomes sensibly denser when the proportion of it is small, ranging from 1·708 to 2·055. But the last experiment of the table is perhaps exceptional, and all the others indicate considerable uniformity of density, The mean density of hydrogenium, according to the whole experiments, excluding that last referred to, is 1·951, or nearly 2. This uniformity is in favour of the method followed for estimating the density of hydrogenium.

On charging and discharging portions of the same palladium wire repeatedly, the curious retraction was found to continue, and seemed to be interminable. The following expansions, caused by variable charges of hydrogen, were followed on expelling the hydrogen by the retractions mentioned:—

	Elongation.	Retraction.
1st experiment	9·77 m.m.	9·70 m.m.
2nd ,,	5·765 ,,	6·20 ,,
3rd ,,	2·36 ,,	3·14 ,,
4th ,,	3·482 ,,	4·95 ,,
		23·99

The palladium wire, which originally measured 609·144 m.m., has suffered by four successive discharges of hydrogen from it, a permanent contraction of 23·99 m.m.; that is, a reduction of 5·9 per cent in its original length. The contractions will be observed to exceed in amount the preceding elongations produced by the hydrogen, particularly when the charge of the latter is less considerable. With another portion of wire the contraction was carried to 15 per cent of its length by the effect of repeated discharges. The specific gravity of the contracted wire was 12·12, no general condensation of the metal having taken place. The wire shrinks in length only.

In the preceding experiments the hydrogen was expelled by exposing the palladium placed within a glass tube to a moderate heat short of redness, and exhausting by means of a Sprengel tube; but the gas was also withdrawn in another way—viz., by making the wire the positive electrode, and thereby evolving oxygen upon its surface. In such circumstances, a slight film of oxide of palladium is formed on the wire, but it appears not to interfere with the extraction and oxidation of the hydrogen. The wire measured—

* *Philosophical Transactions*, 1860, p. 177.

acid, tartaric added so that the solution could be largely diluted without precipitation, and the antimony thrown down by sulphydric acid: the sulphuric acid was then determined in the filtrate as sulphate of baryta. If, on the contrary, the sulphuric acid be precipitated before the separation of the antimony, a sulphate of baryta is obtained, which after ignition is coloured, and retains traces of the metal that cannot be wholly removed by digestion with dilute hydrochloric acid. All the tartaric acid of commerce which I have examined, contains sulphuric acid; digestion of the solution in alcohol with a little carbonate of baryta removes the acid, but the tartrate of baryta is not quite insoluble in the alcoholic liquid. With carbonate of lime no better result was obtained. Through the kindness of Mr. Melvin, druggist of Boston, I received a supply of tartaric acid, in large crystals, which were quite free from sulphuric acid and all metallic impurity.

The precipitated sulphide of antimony was collected on a weighed filter, and dried at the temperature of boiling water; from its weight the quantity of the metal or oxide was calculated. As the antimony was in the state of oxide, and no nitric acid, oxide of iron, or other substance capable of decomposing the sulphydric acid, was present, an excess of sulphur in the precipitate was not to be feared. It has been asserted that the tersulphide of antimony retains at 100° C. a quantity of water, not amounting to 1 per cent, and requiring for its expulsion a temperature above 200°, by which the sulphide is converted into the black crystalline modification. To determine the precise amount of the error from this source, as well as from the possible presence of uncombined sulphur, the sulphide, after remaining many hours in the water bath, and until its weight varied, at most, one or two-tenths of a milligramme, was heated in a covered crucible, in an air bath, to 212°—220° for half or three-quarters of an hour at a time, with the following result:—

0·8192 SbS_3	lost	2·1	0·4	05
0·5445 ,,	,,	1·0	0·3	milligrammes,

no constant weight being obtained.

The sulphide was then exposed to the same temperature, in a bulb blown upon a narrow glass tube, while the air was displaced by a slow stream of carbonic acid.

0·8536	lost	0·2	
0·5199	,,	0·5	
0·6488	,,	0·4	
0·3920	,,	0·25	miligrammes,

these being all products of different analyses; the sulphide was completely converted into the black modification, and the weight on repeated trial remained unchanged. The error, whatever may be its source, of at most the tenth of 1 per cent, becomes insignificant when compared with the tenfold greater errors inevitable in the preparation of the salts.

Tersulphate, or Neutral Salt.—Oxide of antimony and Algaroth powder are dissolved in considerable quantity by hot concentrated sulphuric acid, the latter with disengagement of hydrochloric acid, the solvent power of the acid seeming to increase with its temperature. On cooling, a salt is deposited in slender needles, in such quantity, when the acid is saturated at its boiling point, that the whole becomes a thick semi-fluid magma. The crystals are long, four-sided prisms, with terminal faces, set often upon two opposite sides, alike at both ends of the prism. They seem to belong to the oblique rhombic system. The concentrated acid in which they have formed retains so little of the oxide in solution at the ordinary temperature that it remains clear when diluted with water, but by sulphydric acid a slight precipitate is produced. In the acid, diluted with about half its volume of water, the oxide in the cold is much more soluble.

In the preparation of the salt, the oxychloride was used in preference to the oxide, as the latter is not easily obtained free from alkali, and the acid was heated until all water was expelled, and vapour of hydrated acid abundantly given off. The semi-fluid mass of crystals was brought upon a funnel, the neck of which was imperfectly closed by a glass rod, and they were then further freed from the acid upon the porous plates, as has been described. These operations were performed as rapidly as possible, in frosty winter weather, and in a room which was not heated, and was entered for no other purpose. When dry, the salt formed a mass of fibrous texture, very much resembling asbestos.

My analysis shows this to be the tersulphate, or neutral salt:—

1. 0·5933 of the salt gave 0·3648 SbS_3.
2. 0·6792 of the same preparation gave 0·4173 SbS_3, and 0·918 $BaOSO_3$.
3. 0·6413 of another preparation gave 0·3999 SbS_3, and 0·0859 $BaOSO_3$.

	Calculated.	I.	II.	III.
SbO_3	54·94	52.82	52·78	53·58
$3SO_3$	45·06	—	46·41	46·00
	100·00		99·19	99·58

The difference in the numbers found in the analyses from those given by calculation is to be ascribed to impurity of the preparations rather than to analytical errors. It is obviously difficult, by pressure between rigid plates, to remove completely all adherent liquid, and an excess of acid was therefore generally found in the salts thus prepared. That this was in the present case the cause of the discrepancy will appear when it is considered that the acid which adhered to the salt was hydrated acid, and that its water would be represented in the analysis by a loss. The loss, then, should correspond in amount to the excess of acid obtained; or, reckoned in equivalents as water, should be equal to the equivalents of the acid in excess.

The composition of the salt from the above analyses, taken in equivalents, is—

	II.	III.
SbO_3	1·00	1·00
SO_3	3·22	3·14
HO (loss)	0·25	0·13

The earlier analyses gave—

	Brandes.	Péligot.*	
SbO_3	56·4	50·2	44·3
SO_3	43·2	51·9	53·1
	99·6	102·1	97·4

Mr. Péligot considers the salt to contain four atoms of acid, a composition which requires 47·77 SbO_3 to 52·23 SO_3, if the equivalent of antimony be taken, as has been here done, at 122·34.† The question is one of considerable importance; for from the composition which he has assigned to this sulphate, and to the other antimonial compounds described in his Memoir, M. Péligot infers that the salts of antimony, like those of uranium, depart from the recognised law, according to which oxides containing three equivalents of oxygen require the same number of atoms of acid to form a neutral salt. The existence of such a sulphate of oxide of antimony is denied by him. "En effet il ne m'a pas été possible de rencontrer un seul sel contenant 3 équivalents d'acide combiné avec 1 équivalent d'oxyde d'antimoine; de sorte que pour les sels d'antimoine, de même que pour les sels jaunes d'urane, toutes les formules calculées dans les tables d'équivalents de M. Berzelius représent des sels qui n'existent pas."‡

But the neutral salt may be prepared in another way, with a composition agreeing so nearly with that required by theory as to leave no doubt of its existence. By careful heating in a crucible of the oxide or oxychloride of antimony, with sulphuric acid, until the excess of acid

* The requisite data for calculation are given only for the first of the analyses of M. Péligot. If there be not a misprint, there is an error in this calculation, as occurs also in three out of the four analyses of the sulphates of antimony, of which the details are given. If from 1·66 of the salt, 2·22 $BaOSO_3$ were obtained, as stated in the memoir, there were 45·9 per cent of acid, instead of 51·9.

† Pogg., Ann., c., 563; Proceedings of the Am. Acad., Jan., 1862.

‡ Ann. Ch. Phys., 3d Ser., xx., 297.

is expelled, a white residue is obtained, the weight of which, however, is not quite constant, a minute quantity of acid being continually given off, probably on account of the moisture of the air. To obviate this source of uncertainty, the oxide or oxychloride was put into a bulb blown on the end of a narrow and thick glass tube, bent in the shape of a retort, close to the bulb. The neck was then drawn out so as to end in a point, in which, during the distillation, a drop of acid remained, and deprived of its moisture any air which might pass through it. A platinum crucible, lined with asbestos, served as a bath, and was covered with a sheet of mica, perforated for the passage of the neck, over which asbestos was also heaped. The heat was such as just to cause the acid to distil slowly over, the distillation from between one and two grammes of oxychloride lasting several hours: the temperature was above the melting point of lead. At the end, a minute drop collected in the point, at intervals of from a quarter to half an hour. By too long continuance of the heat the vapour of water-free acid is seen in the tube. The acid in the neck having been driven off, the point was sealed with the blowpipe. The product was a coherent, friable mass, crystalline on the surface to the naked eye.

Of a preparation made from the oxide, 0·4471 gave 0·2823 SbO_3 and 0·5953 $BaOSO_3$; of a salt made from Algaroth powder, 0·6177 gave 0·3946 SbS_3 and 0·815 $BaOS_3$; in the hundred,

	Calculated.	I.	II.
SbO_3	54·94	54·24	54·88
SO_3	45·06	45·72	45·31
	100·00	99·96	100·19

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, January 21, 1869.

Dr. WARREN DE LA RUE, F.R.S., President, in the chair.

THE minutes of the previous meeting were read and confirmed, the donations to the library were announced, and the following certificates read:—For the first time—Mr. E. D. Holditch, Mr. W. Rossiter, Mr. A. K. Howard; for the second time—Mr. E. L. Barret, Mr. J. J. Field, Mr. H. W. Kearns; for the third time—Mr. J. F. Allen, Mr. E. K. Muspratt, Mr. F. W. Hart, Mr. S. Williams. The Society then proceeded to ballot for the four last-named gentlemen, and they were declared duly elected.

The SECRETARY (Dr. Odling) announced that at the next meeting of the Society a lecture would be delivered by Dr. Wallace, "On the Chemistry of Sugar Refining;" Mr. Tomlinson had promised to give a lecture at one of the March meetings, "On Catharism, or the Influence of Chemically Clean Surfaces;" Professor Williamson had likewise promised a lecture; and the council hoped that Mr. Lothian Bell would do the same.

The first paper was then read by the Secretary (Mr. Vernon Harcourt); it was entitled—"*On the Chemical Composition of Canaüba Wax*," by Nevil Story Maskelyne, M.A. This wax is the product of a palm—the *Copernicia cerifera*—known to the Brazilians as the Canaüba tree. The glaucous coating which protects the younger leaves contains the wax in the proportion of about 50 grains to the leaf. It is collected and melted into a mass, and in this state constitutes a pale yellow or greenish body, somewhat harder and less resinous than the wax yielded by the noble palm of the Cordilleras. Its specific gravity is 0·99907, its melting point is 84° C., and it yields 0·14 per cent of ash. The crude wax was saponified by boiling with alcoholic solution of potash containing one-sixth of its weight of alkali, until the liquid became clear. The alcohol was then distilled off and the residue thrown into a solution of neutral plumbic acetate, which produced a yellow colour. The liquid was evaporated to dryness, powdered, and extracted with ether, which removes the wax alcohols. By repeated crystallisations from ether, one of these alcohols, which appears to be melissin, was obtained in a state of purity. The insoluble lead-salt was afterwards decomposed by hydric chloride. In another experiment, the wax was saponified as before, the alcohol distilled off, and the acids set free by hydric chloride. The mass thus formed was dissolved in boiling alcohol, the acids saturated with ammonia, and then thrown down by baric chloride. The alcohol was now distilled off, the mass was thoroughly exhausted with water and alcohol, and the residue reserved for an examination of the acids. The alcoholic extract was digested with ether, and after repeated recrystallisations a body was obtained having the properties of, and corresponding in percentage composition to, melissin, $C_{31}H_{64}O$. To determine its constitution, it was converted, by heating to 270° with potash-lime into the corresponding acid. This acid, when very carefully purified, was highly electrical; it melted at 91°, and only dissolved in alcohol with the greatest difficulty. Its analysis agreed with the formula of melissic acid—viz., $C_{31}H_{62}O_2$ or $C_{30}H_{60}O_2$. Its silver salt contained 19·29 to 19·45 per cent of Ag; $C_{31}H_{61}AgO_2$ requires 18·85, and $C_{30}H_{59}AgO_2$ 19·32 per cent Ag.

It appeared probable, from the large amount of alcohols obtained, that they were present in the wax in the free state; 400 grammes of the wax was therefore boiled a great number of times with alcohol; this quantity yielded 126 grammes of soluble ingredients melting at 81°, and 274 grammes insoluble, melting at 86°. The soluble portion contained a resinous body, to which the yellow colour previously observed was due; this was removed by potash in minute quantity and plumbic acetate. A few crystallisations from alcohol and ether now yielded melissin in a state of purity.

The wax, therefore, contains no less than one-third of its mass of free wax alcohol, a fact of no little interest in vegetable physiology.

After the separation of the first crop of melissin crystals the remaining alcohols, both from the soluble and insoluble portions, were mixed and treated together. By recrystallisation, more melissin was obtained, and by repeated treatment with ether, benzol, and alcohol, several bodies were then separated; the following were analysed, and are described:—

1. An alcohol fusing at 105°, and having a composition represented by the approximate formula, $C_{99}H_{41}O_3$.

2. An alcohol fusing at 78°, and corresponding to formula $C_{46}H_{48}O_2$. It is probably cerotin.

These alcohols are all present in the wax in minute quantity as compared with that of melissin. The author did not succeed in preparing acids from any one of them.

Further attempts to identify the chief alcohol of the wax with melissin were also made. An iodide and chloride of the alcohol radical were prepared and analysed. The latter, however, did not give satisfactory analytical results, and was probably a mixture. Ammonia and aniline both act upon the alcohol, but the products obtained were not fully examined. Sulphuric acid gave an acid the potassium salt of which agrees in composition with the formula $C_{31}H_{63}KSO_4$.

A note attached to the paper mentions that the research was made in the years 1855-7, the author having since then been unable to complete it.

The PRESIDENT, in offering the thanks of the Society to the author, remarked that Sir Benjamin Brodie, who might be called the father of the study of wax, was present, and would perhaps favour the Society with some remarks.

Sir B. BRODIE, who observed that he had not come in time to hear the commencement of the paper, hoped that

its publication would induce some other chemists to apply themselves to the study of wax; he said chemists, because the necessary investigations were so tedious as to require the labour of two or three persons. He himself would be very happy to render any assistance he could to anyone who was willing to take up the subject. One of the chief obstacles to be encountered arose from the extreme difficulty of deciding from the percentage composition the true atomic constitution of the compounds. He regretted that Mr. Maskelyne had not applied some of the methods which he had found useful in fixing the constitution of these compounds. The action of chlorine, for instance, gave substitution compounds analogous to chloral which were very characteristic. In the same way, it would have been almost impossible to decide by analysis whether the paraffins belonged to the ethylene or marsh gas series, but the action of chlorine upon them was perfectly definite, and tended to fix them in the latter. Another most excellent method of study consisted in forming the ethers of the wax acids, and examining them.

In the study of wax, the composition of the bees'-wax produced in different countries would be found well worth investigation. He (Sir B. Brodie) had found that bees'-wax from Ceylon was quite different in composition from English; it contained no cerotic acid, whereas the English wax always contained that acid in the free state. The animal wax, called cerolein, too, with its peculiar tea-like fragrance, should be examined. Its composition appeared to approximate to that of butyric aldehyde, but it was very little known. Possibly some of the candle-makers could supply the crude material. It must be extracted by alcohol, and the cold solution evaporated.

"*On the Connection between the Mechanical Qualities of Malleable Iron and Steel, and the Amount of Phosphorus they Contain*," by Dr. B. H. Paul. It is generally considered that very small quantities of phosphorus in malleable iron and steel are most prejudicial to the quality of the metal. Quite recently, an eminent metallurgist has stated as a fact that much less than ·3 per cent of phosphorus produces a decided and injurious effect on steel. The author has, however, been unable to discover any evidence sufficient to justify such a conclusion, and still less any reasonable explanation of it. He has recently had an opportunity of testing the truth of this conclusion, by determining the phosphorus in some samples of the iron and steel made by the new nitrate of soda process from British pig-iron known to contain phosphorus. Seven bars of iron and two bars of steel, made by the Heaton process, were examined; their tensile strength and extension had been determined by Mr. Kirkaldy. The iron bars had a tensile strength of from 46,547 to 52,842 lbs. per square inch of area, and an extension, when subjected to this strain, of from 21 to 28·6 per cent of their length. The two cast-steel bars had tensile strengths of 80,916 and 106,602 lbs., and extended to 3·3 and 13·7 per cent of their lengths. In the iron bars, the author found ·144 to ·38 per cent of phosphorus (average ·237 per cent), and in the two steel bars ·24 and ·241 per cent. The author, therefore, thinks himself justified in asserting that the commonly-received opinion on this subject does not always represent the truth.

Professor MILLER had had opportunities of examining some of these steels. In fact, he might say that Dr. Paul's experiments had been suggested by himself. He had found in some careful analyses of his own, very unusual quantities of phosphorus, even in samples of high class iron—iron which worked well cold, and also at a red and bright yellow heat. It could hardly be doubted that in many statements of the composition of iron the amount of phosphorus found had been too low. The old method of estimating the phosphoric acid, which involved the throwing it down as iron-salt, was unreliable. The phospho-molybdate process, employed by Eggertz, was undoubtedly the best; but even this required the greatest care to avoid getting too low a proportion of phosphoric acid. It was very difficult to ensure the entire precipitation of the phospho-molybdate. One thing was clear from these experiments, namely, that the presence of from 2 to 3 parts of phosphorus in 1,000 of iron was not so detrimental as was generally supposed.

The PRESIDENT inquired how the phosphorus existed in the iron, and the form in which it was eliminated during Heaton's process.

Professor MILLER could not speak with certainty of the condition of phosphorus in the iron; it probably existed as phosphide. It was, however, most certainly eliminated in the form of phosphate.

Dr. PRICE remarked that there was nothing new in the statement that such quantities of phosphorus might exist in wrought iron, but that with regard to steel he had yet to learn that ·24 per cent of phosphorus could be present without injuring the metal. With regard to methods, he believed that the one at present in use was absolutely correct, that, namely, in which the phosphorus was separated as phosphate of iron and then determined with magnesia. The molybdate method was excessively tedious.

Mr. FORBES said that in Sweden they would not receive for making steel, iron that contained ·1 per cent of phosphorus. Many works had had to stop for want of ores that were free from phosphorus. For one mine of such ore there were ten which yielded ore containing phosphorus, and they would most gladly use it if they could. He could not agree with Dr. Miller that the amount of phosphorus in iron was underestimated. The molybdate process was thoroughly understood in Sweden, and had been in use since 1856. Errors in the estimation of phosphorus could not be due to ignorance of that method.

Professor MILLER explained that he only meant to say that the molybdate process required care. No doubt the results obtained by Eggertz were perfectly correct. In answer to the President, Professor Miller then gave a short account of the Heaton process. A quantity of the nitre was placed in a wrought-iron pot lined with fire-clay; on this was put a perforated plate of iron, and 12 cwts. of melted cast-iron from a cupola furnace were then introduced, with sand and lime. During the reaction, fumes, first white, then brown, next grey, were evolved. A violent flame and a roaring noise attended upon it. When again tranquil, the metal was emptied on the floor of the furnace; the slag ran out and the pasty mass was pressed between rollers. He was unable to tell the proportion of phosphorus in the slag. The crude cast-iron employed contained 1·43 per cent, and the cast-steel obtained under ·3 per cent. A part, at least, of the phosphorus lost was certainly to be found in the slag.

Dr. PAUL quite agreed with Mr. Forbes that Swedish steel was free from phosphorus. As far as he could learn, there was no other evidence in proof of the injurious action of phosphorus on steel.

NOTICES OF BOOKS.

The Scientific Review: a Monthly Record of the Progress of Science and its Application to the Arts and Manufactures (with which is incorporated the Journal of the Inventors' Institute). Conducted by R. MARSDEN LATHAM, Esq. Vol. iv., No. 1, January 1st, 1869.

FOR obvious reasons, one scientific journal seldom criticises a journal devoted to the same field of enquiry, nor shall we depart from this wholesome rule; but as this number has been forwarded to our office "with the editor's compliments," and as it contains some very original views and some trenchant strictures on world-renowned names, we feel constrained to allow the *Scientific Review* to vindicate its peculiar claims to a hearing, confining ourselves mainly to quotations, but taking the liberty of italicising a few noteworthy passages.

Of the Heaton process for manufacturing steel, the editor writes:—

"*Any tyro in Chemistry* can perceive how nitrate of soda acts in refining impure iron, whatever be the quality of the product obtained."

In noticing the proceedings of the French Academy of Sciences, the editor calls M. Jamin's differential refractor for polarised light—

"An ingenious optical instrument, by means of which the torturing of a beam of light is pushed to a most exquisite degree of perfection."

The following query will doubtless receive the attention of the Academy of Sciences:—

"M. Gaube—a name which is new to us—read a paper on the composition of that beautiful little plant—the pest of our gardens—*Achillea Millefolium; pray why does the Academy omit to print this note?*"

Referring to M. Janssen's recent spectrum observations, we read:—

"The day after the famous eclipse of the sun, M. Jansen imagined that by directing a spectroscope to the borders of the disc he might prove that the great protuberances were still visible (or rather their spectrum), and found that such was the case. . . . This simple observation, *which might have suggested itself to a schoolboy of ten years of age*, has given rise to a considerable number of short notes addressed to the Academy, and would appear, from the interest attached to it, to be one of the most marvellous discoveries of the age!"

Professor Hofmann is next favoured with the editor's disparagement.—

"Professor Hofmann continues his researches on certain compounds isomeric with sulphocyanic ethers, and *illustrates them, as usual, with a host of useless formulæ*, which detract considerably from the interesting facts which he brings forward."

And thus is Professor Tyndall's latest discovery estimated:—

"The author encloses certain gaseous substances in a glass tube, and passes through the tube a beam of electric light. This gives rise to various *optical* phenomena; certain colours and forms are produced in which Professor Tyndall sees evidence of *chemical* decomposition. *We must confess that we do* NOT *see it.*"

The longest article in the number, by Dr. Macvicar, is devoted to "The New Chemistry." The distinguished inventor of the tetrad will feel interested in hearing that the tetrad is the basis of the system, and that—

"The four etherical atmospheres or dynamospheres of the four constituent units of weight of the tetrad are conceived to be unified into a sphere, so that, while the nucleus is tetrahedral, the peuphery [*sic.*] is spherical, and the form, therefore, embraces within its limits all possible symmetrical polyhedra."

Our younger readers who lately witnessed Dr. Odling's brilliant experiments with the oxyhydrogen flame, will be glad to have the following lucid explanation of a phenomenon which the lecturer was necessarily obliged to describe somewhat briefly; and with the following dithyrambic strain, inspired by H and O, we cannot more fitly conclude:—

"Our hydrogen and oxygen are so dissimilar in every morphological feature, that whenever they have a chance they must unite with great force; the atom of H plunging with great velocity into the centre of O in the line of its axis, and generating intense heat or palpitation of O. Hence it is only to be expected that when both exist in the free state without any trentagonal element present to be a mould for O, and to sustain its singular from the latter in the instant of the genesis of HO will shake itself free of its peculiarity of form, and open so as to let the axes of the five bitetrads of which it consists fall parallel to that of the incident atom of H, which also acts as a linear force, and a wedge insisting on this transformation."

CORRESPONDENCE.

ARTIFICIAL FORMATION OF ATACAMITE.

To the Editor of the Chemical News.

Sir,—Permit me to refer, in a few words, to Mr. Field's interesting communication to the Chemical News on the subject of atacamite.

I was aware that atacamite had been formed artificially in several ways. But my experiments were made with the intention of trying the action of chloride of sodium upon *all* the common ores of copper occurring in Cornwall. And I wished to do this under perfectly definite conditions. The paper in the *Journal of the Chemical Society* gives the only one of my results which approached success. Other experiments, with malachite, redruthite, chalcopyrite, &c., have not yet been completed.

It will be recollected by the readers of my papers on cupric oxychlorides in the *Journal of the Chemical Society* (1864) that I therein showed that the Cornish atacamite, first described as an English species by me, had the same composition as the Chilian specimens analysed and described by Mr. Field.

I need scarcely add that the correction suggested by Mr. Field in the wording of a sentence in my paper gives the meaning intended to be conveyed by the paragraph in question.—I am, &c.,

A. H. Church.

Royal Agricultural College, Cirencester.
Jan. 27, 1869.

THE COHESION FIGURES OF LIQUIDS: OLEOGRAPHS.

To the Editor of the Chemical News.

Sir,—I have received a number of applications for an opinion on Dr. Moffat's oleographs of the cohesion figures of liquids. Several persons who deal in, or use oils largely, are anxious to make use of the process, provided its results be reliable. Perhaps you will allow me to give my reply through the medium of your journal.

Dr. Moffat has been so good as to send me thirty-six impressions illustrative of his ingenious process. I am sorry not to be able to report favourably on them as types of cohesion figures. Their chief fault is the absence of distinctive character. These thirty-six oleographs are so much alike, that they might fairly pass for variations of one oil. They consist, more or less, of a large disc perforated with holes. This arises from allowing the oil to remain too long before an impression is taken. There is a moment in the existence of every film, when the characteristic figure is presented, by which it can be recognised and the purity tested. If this characteristic figure could be seized and fixed at the right moment, the process would be of value, for we should then not only have figures of great variety and beauty (those of no two liquids being alike), but such figures would serve as types for comparison: whether the oleographic process is capable of grasping this result, I cannot say; but I think an attempt ought to be made with that end in view. I have published a considerable number of figures in which the characteristics are presented. Some liquids, such as the oils of lavender, turpentine, coriander, &c., may have each two or more characteristic phases; these should, if possible, be given.

In the *Philosophical Magazine* for June, 1867 (Plate IV.), are represented the three characteristic phases of oil of coriander. Now no oleograph of this oil would satisfy me that did not represent these three figures. The third figure of this group would print as a perforated disc, as in Dr. Moffat's oleographs, but this itself would be of no value at all, for it would distinguish nothing unless associated with the other two phases which distinguish oil of coriander from all other liquids. Oils of the same family

present figures with broad features in common, but with essentially different details. No one, for example, would hesitate to distinguish between castor and croton oils; but if the figures were left one, two, or three minutes on the water or other surface, all character would be lost. Before any one attempts to fix these figures, he should educate his eye (and this may soon be done) by a careful study as to what one liquid does that is different from any other liquid, how long it takes in doing it, and whether the peculiarity in question can be fixed at the right moment.

Supposing the oleographic process to be made capable of fixing the characteristic forms of these figures, it can, I suppose, never be made to fix the colours which often greatly heighten their beauty.—I am, &c.,

C. Tomlinson.

Highgate, N., Jan. 19, 1869.

MISCELLANEOUS.

Glasgow Philosophical Society (Chemical Section).—A meeting was held in the Society's rooms, Andersonian University, on Monday, the 18th inst., at eight o'clock in the evening, Dr. Anderson, president, in the chair. Six new members were admitted. A paper was read, by Messrs Bald and Mactear, "On the Salt Deposits of Strassfurt." We hope to be able to give this paper in detail in our next issue.

Testing the Strength of Acetic Acid.—In attempting to determine the strength of acetic acid by means of the hydrometer, it will be remarked that certain anomalies present themselves; thus, there is no difference in the specific gravities of acids containing respectively 53 and 100 per cent of true acetic hydrate, both having precisely the same density, 1063, at 60° Fahr. (water = 1000). The heaviest liquid acid is that containing 80 per cent, the specific gravity of which is a trifle over 1073; but from this point upwards to the acid of 90 per cent there is no appreciable difference in the gravity. Again, a sample weighing 1067 may either represent an acid of 60 per cent or may contain as much as 98 per cent of true acid. It is, therefore, customary to guarantee the highest degree of concentration by specifying the temperature at which the acid becomes solid, or, rather, the highest point at which the already glacial acid resists liquefaction. Another guide which may often prove serviceable in the identification of an acid which, although of a high degree of concentration, is not actually glacial, is the fact observed, we believe, independently by M. Berthelot and Mr. E. Chambers Nicholson, that such acid becomes inflammable when the temperature is raised to the boiling-point. If we take, for instance, about a drachm of the acid of 95 per cent and heat it in a test-tube to the boiling-point, it will be found that the vapour takes fire on applying a lighted match, and burns steadily as long as the ebullition is maintained; if, however, 10 per cent of water be mixed with the sample there will be great difficulty in causing inflammation, and the vapour when ignited will only burn with a lambent flame of pale blue separated cones, whilst below this strength the acid vapour is altogether uninflammable. By this test, then (avoiding a too prolonged ebullition, which increases the strength of a weak acid), we have a ready means of estimating the quality of liquid samples of a high degree of concentration without resorting to the more tedious method of acidimetry. It has only to be stated, in conclusion, that the boiling-point of the ordinary qualities of acetic acid, although higher, is so little removed from that of water that the indications of the thermometer are not much more to be relied upon than those of the hydrometer. In many respects carbolic acid imitates the deportment of acetic acid in the characters above described; it likewise becomes glacial upon separation of the last traces of water.—*The Photographic Journal.*

NOTES AND QUERIES.

Separating Iron and Brass Dust.—Certain improved apparatus for separating filings or other small bits or particles of iron or steel from other metallic filings, scrapings, chippings, or other small particles or dust, by use of magnets. Patentee, William Thomas Bissell Allday; No. of Patent, 67; date, January 10th, 1860. Address, Rednall, Worcestershire.

Ice-House.—"Zero" may find a very good account of the mode of constructing an ice-house in Ure's "Dictionary of Arts, Manufactures, and Mines," published by Longmans, sixth edition, vol. ii., p. 643. The article is accompanied by a woodcut, and is too lengthy to be properly abstracted in "Notes and Queries"; the work alluded to is found in the Library of the Commissioners of Patents.—Aliquis.

MEETINGS FOR THE WEEK.

Monday, 1st.—Medical, 8.
—— London Institution, 6.
—— Royal Institution, 2. General Monthly Meeting.

Tuesday, 2nd.—Royal Institution, 3. Mr. Westmacott, "On Fine Art."

Wednesday, 3rd.—Society of Arts, 8.
—— Pharmaceutical, 8.

Thursday, 4th.—Royal Institution, 3. Dr. Foster, "On Involuntary Movements of Animals."
—— London Institution, 6
—— Royal, 8.30.
—— Chemical, 8. Dr. Wallace, "On the Chemistry of Sugar Refining."
—— Royal Society Club, 6.

Friday, 5th.—Royal Institution, 8. Mr. James Fergusson, "On Tree and Serpent Worship."
—— Geologists' Association. Anniversary Meeting, 7.30.

Saturday, 6th.—Royal Institution, 3. Dr. Odling, F.R.S., "On Hydrogen and its Analogues."

TO CORRESPONDENTS.

*** Vol. XVIII. of The Chemical News, containing a copious index, is now ready, price 12s., by post, 12s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes, are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xix. commenced on January 1st, and will be complete in twenty-six numbers. It will contain a verbatim report of Dr. Odling's Juvenile Lectures at the Royal Institution "On the Chemical Changes of Carbon," and original papers from some of our leading English and Foreign Chemists and Physicists.

The Royal Astronomical Society.—The following startling news appears in a contemporary:—"The announcement has recently been made to the Royal Astronomical Society of England of the discovery, by means of the spectroscope, of a hitherto unknown envelope of gaseous matter *surrounding that body*, of a thickness of seven or eight thousand miles. Its precise composition has not yet been determined, but will probably before long be ascertained." It is to be hoped that immediate steps will be taken to rescue the Fellows of this learned body from their perilous position.

Professor Attfield's communication "On the Igniting Point of Petroleum" is unavoidably postponed until next week.

C. Hunter.—One cell of a battery will not efficiently decompose water; you will require two or three cells at least. If the zinc plates are properly amalgamated there will be no frothing in the cell.

J. W. C.—We cannot undertake the responsibility of saying whether any particular individual is a "respectable practitioner" or an "advertising quack." As a rule respectable practitioners do not advertise.

F. D.—We know of no book which treats on the formation, fitting-up and management of a laboratory. Much depends upon the kind of work to be done in it; whether research, or commercial analyses; how many assistants are employed, and if pupils are taken. Length of purse is also an important consideration. As you say expense will be no consideration, the best plan will be to see as many private and public laboratories as possible, select the most useful points from each, and then draw out a plan for yourself. You will find it advantageous to consult Greville Williams's "Handbook of Chemical Manipulation" before deciding about the final arrangements.

Communications have been received from Dr. R. Angus Smith, F.R.S.; G. F. Rodwell; H. Renshaw; E. Hart; J. W. Clements; R. Mallet, F.R.S.; C. Hunter; J. Samuelson; W. T. Suffolk; Professor R. Fittig; M. Aguilar; G. Henry; A. M. Scott (with enclosure); A. Wuth (with enclosure); H. McLeod; A. N. Palmer; J. C. Lee (with enclosure); Dr. Noad; R. N. Shaw; Mottershead and Co. (with enclosure); R. R. Tatlock; Dr. Odling, F.R.S.; T. Hill; J. Spiller; D. Sauz; and Professor Church.

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SCIENCE AND VIOLENCE.

HISTORIANS tell us that there is a vein of thought running through even the empires of the battle-axe. We think the vein in many cases thin, and especially in ancient times when the elementary instinct of power governed more fully than in later days. The motives of men become more complicated as their affairs become more numerous, and nations contain as many reasons for action as they contain families. In old times men were not ashamed to confess their simple love of greatness and, in default of that quality, their love of admiration. They liked to be carried about like some Queen of the May, or with elephants to increase their apparent size, and numbers to atone for their actual littleness. We must not despise these promptings of nature—these undefined strivings after the beautiful and the good. According to an old northern saying of our people, "it came up the back to do so," explaining an unknown impulse by a vague feeling that the whole column of the body was filled with a power that took its own direction.

When victory produces self-satisfaction and leisure, there is an attempt to think more clearly, and we have every nation giving out with more or less fulness its own theory of itself and its relations to the universe. They seek wisdom for a little and encourage learning, but always with the rod in hand, always letting you understand that above all stands power. Their rights are those of the New Zealanders—"I ate the former possessor."

Still this love of wisdom has taken a very brilliant form at some courts, and in part the love has been sincere. The old laws of Manu enjoined it, and gave orders to the king to learn "from those who knew the three Vedas the triple doctrine comprised in them together with the primeval science of criminal justice and sound policy, the systems of logic and metaphysics and sublime theological truth; from the people he must learn the theory of agriculture, commerce, and other practical arts." Here is seen the love of wisdom and goodness which has burnt in the East at various times and places more violently than we can now imagine, so that at some periods it seemed certain to take the lead in all governments. Kings and courts were dazzled by knowledge, and wise men were invited and honoured, whilst systems of abstract thought grew up in such variety that it is hard to find one in Europe which has not existed previously in the East. So familiar, indeed, had they become that many sunk down by a natural decay to less serious thinkers, and after various transformations, when their masters died, fell exhausted in some ignoble *reductio ad absurdum*. That this is true we may illustrate by the account of the ostler stealing his master's horse and caricaturing the idealists by saying that there was no horse, it was only an idea. The master returns the same answer after he gives him a flogging, saying that, in reality, he had received no flogging; exactly as Johnson and Boswell laughed at Berkeley instead of the far-distant Fartosh. It is melancholy to see great thoughts coming down in the world like decayed families, as a Greek emperor might have seen, had he looked forward, his descendants intended for a throne dying unknown and lonely on the extremity of our distant island. We tremble for our race when we think of the East and look on men who loved truth so devotedly dying apparently by millions, rubbed off the floor of life by the sweeping hand of the selfish love of power. These scenes were in struggles for magnificence, in which sunshine and glitter had the victory. That is a wonderful place where the sun shines; and the greatest pun perhaps ever made was the saying "Light comes from the East,"—for after all it is a pun.

Passing over times and places, we find that to invite wise men to courts became such an admired taste that King Arthur, we are told, had two hundred philosophers at his court. Nothing shows the bent of men more than the statements of romance: there men do exactly as they please. We had certainly an inclination to run through the ages, and examine the relations of men of science and learning to power. It is a good habit, we think, the comparison of times; and we do not care to be laughed out of it by the story of the German writer on police, who began his history, whether real or mythical, in the words "Adam was the first policeman." We have seen with our own eyes a claim made for this name as the first freemason, a no less wonderful piece of literature. We move more freed from present human prejudices in ancient times; as soon as we arrive at the breakage of the Roman empire, or perhaps rather at those ages where the busy roots of modern life grew in darkness, men became as cautious of speech as if they were at the back of their friends. In old times there began a simpler relationship between the men who had original thought and those who had power. But the two powers did not coalesce well, and one thinks with shame even now of Plato attracted, shuffled off, and re-attracted to one Dionysius after another only to be repelled at last. In earlier times one feels sorry for poor Crœsus seeking the sympathy of the wise, and one learns by such things that they knew their position as well as any can know it now, although they have been obliged to move to the side as the sword came in their way. Indeed, we feel that it must have been a great country that felt, even in the advanced social period, that Diogenes was a power. A small people would have despised him, and it would require the most choice of our time to treat such a one with attention such as he met.

In reality, however, we have not much to do with such men; they were not the intellectual ancestors of chemists, although, being somewhat related, since men who thought on matter and mind were more allied in old time than with us, we think it interesting to see how, as a race, they were treated by the men of action of the time. Whenever these desired to fight for their interests, they cleared the ground of all such impediments as learning produced, just as they would have removed beggars and strolling minstrels. Perhaps scientific men are rather the descendents of astrologers and magicians that graced the courts of the East, and who at times seemed to have real power and at other times were superior slaves. The time of action came, and they were scattered like mummers. The scientists may spring from the physicians of Egypt who advanced so far in their division of labour that it was considered that one part of the body was enough for the study of one man. They must have risen high when one who was sent to the Persian court was so incensed by the removal from his wife and family that he found means to cause an invasion of Egypt, according to a report. But although we may view them as we do, cultivating chemical knowledge with some success on the Nile, we see them also as unhappy instances of the fact that the man of mere action has had his way, and the nation has long suffered the deepest degradation.

Ever will the man of mere action put aside the best, that his little purpose may flourish. We have heard of an engineer who proposed in this, our own island, to drive a railway through a park which had been the property of the citizens longer than history could tell, so as to save a slight curve, such as he often made apparently for his amusement. We have heard of another who proposed to carry a similar road through an ancient church, in which the bodies of kings and queens had lain for centuries, and had fascination to delude others into the crime, and now the spot is made the stable of screeching and unfeeling locomotives. It is always the same with the man

of mere action; we have seen him in various conditions but he is always one. He has cheated us at marbles, where his principles were fully developed as a chicken's are from the shell; we have seen him grown into manhood, and he has bullied and browbeaten us, and we have seen him old, when he has wheedled and made use of us. His demands are for himself. We have known him wandering over Europe for inventions for which he obtains a patent, careless of the fact that another is the inventor, and when this has failed we have seen him trying to prove that no man has a right to keep his own discoveries to himself, hoping by this means that the sharpest eye and longest purse will seize and keep them. He has even obtained the apparent consent for the time of some most eminent men, having deceived the very elect of the nation. He wishes to seize the golden egg as soon as it is laid, but he cares little for the life of the hen. That egg will last his day. Everywhere he is the same; he will open the world with his sword; it is to him a mere oyster or food supply, and it matters nothing to him if he sacrifices the life of a saint or a fly. Shakespeare saw one undisguised on a heath near Forres when describing himself in these words, "and like a rat without a tail, I'll do, I'll do, I'll do." This expresses activity without thinking.

There is, however, the man of action in the higher sense inspired by thoughts and working them out. Him it is probable no man can equal; such have become the most admired of mankind, but as every one has his hero we shall make no allusion, as it is not of consequence to stir up opposition on a point little to be regarded here.

The man of mere action, whose principles are self, differs so much from the man of action governed by love of his race, that in narrowness one can only compare him with the bridge of Sarat which, if he ever cross, it will be because he surpasses it in narrowness. To us he seems better named the man of violence. He has never learnt principles, and to a man who cares not for these we need not speak of science; its volumes turn into receipt books.

It has been said that the government of this country does too little for scientific men. The work of science, like other departments of thought and action, has been left to be developed by the genius of the country. Looking at the history of scientific ideas, it seems to us that our nation has not much to fear in comparison with others; We shall even go farther, and say that for breadth of views no nation can go beyond us. We are even still more prejudiced, and are inclined to think that, taking the larger and wider theories into consideration, we have done more than our share. The national force has been great, and that instinct which has produced so many poets of the highest class has also produced bold thinkers leaping our fields of thought with seven-leagued boots, whilst the workers on the fields have been too few for full cultivation. We are not quite prepared to prove all this, but we have long thought it, and it is not a matter on which to produce rapid conviction to an opponent. But, from whatever cause, we consider ourselves lagging: our powers are not made the most of; we consider that in this country the number of purely scientific men is too small. We think, too, that the powers of the whole are not fully brought into action. There is also a want of care to produce a supply, and, when produced, to give them position. The country must suffer by this in every department where science is of value.

The first result of this belief, which is held by all men who think on the subject, is to blame the government. We, too, have had an inclination to do so, and there we must seek help; but as a question of morals, who is to blame? If we search the factories of this country, do we find that the manufacturers have been before the government, and that they have made such use of scientific men and scientific knowledge as to enable them to stand guiltless? Our belief is against this. We stand guilty as a nation of an attempt to ride over principles of science and to obtain results by the violence of our activities.

There have been many wise men who have devoted great sums to the nation, that those after them might be taught without cost, but ever these witches from Shakespeare have come and have wrested the power from their hands, turning it to baser ends. The man of selfishness and mere action has been, as usual, at the money boxes; and he has done more: he has lived on the brains of whole cities and counties. He has darkened whole generations for whom his father had provided light; and it is not much to say that for every day's food a family has been ruined. Cannibals are more easily taught, and less likely to return to their feasts. In early times we have seen them in the governments; in modern times they are more difficult to find: they hunt after charities provided for the poor and ignorant, or take hold of others shares that make them rich as princes.

We desire protection from these men of violence. We look on the keen minds of our ancestors, and say to ourselves "if such men as these had found peace and fair-play, what a world we should now have." We read the words of Roger Bacon, written 600 years ago, and most interesting to chemists:—"The elements are made out of *yle*, and every element is converted into the nature of another element, and everything into everything; for barley is a potential horse—that is, by its occult nature, and wheat is potentially man, and man is potentially wheat." When men begin to put the problems of nature so sharply before them, they enquire. Let us suppose *yle* to be the substance of the metaphysicians, and we have an opinion little differing from one lately put forward to account for elements, although disagreeing as to the transmutation—a point that most chemists will very willingly concede in theory. Well, this style of enquiry was suppressed by authority, and it is for others better acquainted with our old universities to say if up to this century a more advanced knowledge of matter was received by those who studied at Oxford. Six hundred years have been given for the study, and we think we have met many behind Bacon. He certainly thought Oxford a proper place for such studies. Let us imagine the world, if he had been encouraged to make a school; but one step may destroy a life, and that solemn truth stands before us every day. We seek protection from governments, although they in old time have destroyed so much that thoughtful men built; but the men of violence have changed their beat, they are not in authority, they find more to be gained by lurking in secret.

It is not for single individuals to protect themselves—they stand as nothing before their fellow men, on rare occasions excepted, when they become representative it is not even possible for a community to protect itself—it lives, but its organisation does not continue permanent except in its government. It is only the immortal that can protect us through generations; and in the State we have the nearest approach to that continuance which savours of immortality. It is for this reason, then, that we must look to governments, not as men unable to help themselves, but as men who, having less than a century to live, implore for the young the aid of that whose life will remain to long futures.

There has been in England a pride of individual life which has brightened its annals in a manner peculiarly glistening, but has greatly prevented the concentration of its power in many directions. Its too practical eye has never seen the abstract living government moving on through all generations, muttering its thoughts through changeable men, and has failed too much to know that this could act as a lens whereby the people's power could be intensified. As men, we are not narrow, and there is an elasticity in our institutions which allows of great width; but from whatever cause, our universities have been lacking in breadth, and they have taught our statesmen. Out of the earth, deep among the roots, has grown the sap of new institutions, and the nation must

drive on the learned men who were appointed to lead it. It is a misfortune, and because of this it seems needful that universities shall no longer be few in number, so that all the country should be shaped in one groove, but sufficiently numerous to present oppositions to any body of men who will too exclusively pursue one idea. The existence of such will be a safegaurd to the nation, who will be able to have a choice of education for their sons, whilst the control of government will prevent them sinking into those private depths of selfishness which have drowned so many endowments. If education is not under a great public control the funds will be again wrested from their proper ends. The government only can protect the land from "the violence of men that dwell therein."

ON THE

SULPHATES OF OXIDE OF ANTIMONY.

By W. P. DEXTER.

(Concluded from page 57.)

Basic Salts.—The basic sulphates of antimony form a series of salts in which the oxide is combined with two, one, and half an equivalent of acid. Besides these, there appear to be others, only one of which I have examined. and which are probably combinations of these simpler salts, They occur under various and often unexpected conditions; but, in general, the degree of dilution of the acid seemed to have the greatest influence in their production. When oxide of antimony is boiled with sulphuric acid diluted with about its volume of water, a turbid liquid is obtained in which, under the microscope, no distinctly crystalline body can be perceived. On continuing the ebullition, when the acid has reached a certain degree of concentration, the liquid, provided more oxide be present than it can dissolve, becomes suddenly clear from the subsidence of a heavy sand-like body. If the boiling have been stopped as soon as this takes place, the substance will be found under the microscope to consist of flat rhombic prisms of considerable size. By continuing the boiling but for a few seconds these disappear, without any change of appearance perceptible to the eye; but by the microscope the prisms are seen to be replaced by octahedral crystals. Generally, however, the prisms are from the first mingled with the octahedral salt, from which it is very difficult in this way to obtain them quite free. By a slight concentration of the acid, as has been said, the octahedra are left perfectly free from the prisms.

These octahedra appear to belong to the regular system, are frequently more or less distorted, but very seldom show any replacement or modification of the crystalline form. The faces are striated, and to these little projecting angles, acting like prisms, is due, it seems to me, the slight amount of colour which they exhibit in polarised light. As the liquid in which they have formed cools, crystals resembling those of the neutral sulphate generally separate. To prevent admixture with these, the porous plate upon which they were collected was covered and imbedded in hot sand. In their analysis were obtained—

1. From 1·1663 salt, 0·863 SbS_3 and 1·1815 $BaOSO_3$.
2. From 1·1359 of another preparation, 0·847 SbS_3 and 1·1724 $BaOSO_3$.

	Calculated.	I.	II.
SbO_3	64·65	63·57	63·91
$2SO_3$	35·35	34·79	35·44
	100·00	98·36	99·35

The salt is the bisulphate, and its formula SbO_32SO_3

Mr. Péligot, by the action of fuming sulphuric acid upon oxide of antimony, obtained a salt "in the form of small, brilliant crystals," of which he has given the analyses:—

SbO_3	63·0	64·3
SO_3	37·1	35·0

and which therefore seem to have been the salt just described. In fact, hydrated sulphuric acid, gently warmed, unites with the oxide to form this compound, which is then dissolved at a higher temperature, with production of the neutral salt.

In the formation of both the octahedral and prismatic crystals, there appears to be direct conversion of the undissolved oxide into the salts: they are also deposited from a solution of the oxide in sulphuric acid of the proper concentration. There is, however, a peculiarity attending their formation. When they have separated from the acid liquid, they can be decomposed by addition of water, and again reproduced by concentrating the liquid. But if by still further evaporation they have been re-dissolved in the acid as neutral salt, or if the oxide be at first dissolved in concentrated acid, and the solution in either case decomposed by water, on evaporation the octahedral crystals will not be obtained, or will be obtained only in small quantity; the separated basic salt re-dissolves at last completely in the acid. By arresting the evaporation at the proper period, as has been said, octahedral crystals may be deposited from the liquid on cooling, but no conversion of the basic salt into them seems to take place. By decomposing the basic salt with carbonate of soda, and treating the resulting oxide with dilute acid, the octahedral crystals can be again produced.

Finding it difficult to obtain the salt mentioned as occurring in flat prisms free from the octahedral crystals by concentration of the acid liquid in an open vessel, experiments were made with acid of various degrees of dilution. An acid of sp. gr. greater than 1·6, gave by boiling with the oxide octahedral crystals: at 1·597 the prisms first appeared: at sp. gr. 1·57 the oxide was converted into prisms free from the other salt, but smaller than those produced by the gradual concentraion of the liquid; and at 1·554 the product consisted only of needles. So that the production of the body in question is confined within narrow limits of concentration of the acid. The salt was dried, like the bisulphate, upon a plate surrounded with hot sand.

Of two different preparations,

0·624 salt gave 0·4864 SbS_3 and 0·571 $BaOSO_3$: (I)
0·524 ,, ,, 0·4097 SbS_3 and 0·479 $BaOSO_3$: (II)

Whence their composition was

	I.	eqvts.	II.	eqvts.
SbO_3	66·97	3.00	67·17	3·00
SO_3	31·42	5·16	31·39	5·13
HO (loss) ..	1·61	1·17	1·44	1·05
	100·00		100·00	

and their formula $SbO_3,5SO_3,HO$, which requires

SbO_3	67·75
SO_3	30·86
HO	13·9
	100·00

The salt is most probably a compound of two atoms of bisulphate, and one of protosulphate—

$$2SbO_3,2SO_3+SbO_3SO_3,HO.$$

This composition explains the facility with which it is changed by prolonged boiling, and concentration of the liquid into the bisulphate; it being only necessary that the equivalent of water be replaced by one of acid.

The crystals of this salt appear large and well defined under the microscope with medium powers. They are four-sided prisms, having for their section a rhomb with very unequal angles, and terminated by two or four faces, which, from the flatness of the prisms, are not distinctly visible: they belong apparently to the right rhombic system. Formed by the gradual concentration of the acid, they have always the same form; but by exposure of the liquid, or of a solution of the oxide in dilute acid, to the

air, crystals are obtained of the same general appearance, which seem to be of the oblique rhombic system.

By exposure for several weeks to the air of the liquid from which the prisms had separated, a fine white powder was deposited, consisting of minute irregular needles, in which, with a power of about 600, no further shape could be made out. The quantity was only sufficient for one analysis, and a subsequent attempt to form them did not succeed. 0·3447 gave 0·2668 SbS_3 and 0·2167 SO_3.

	Calculated.	Found.
SbO_3	74·92	73·89
SO_3	20·48	21·59
HO	4·60	(4·43)
	100·00	100·00

The same salt, without the atom of water, was made by Brandes by the action of alcohol upon the neutral salt. I have obtained in this way a salt in small needles, but which was not analysed.

The last of these basic salts, the combination of two atoms of oxide with one of acid, has been described and analysed, both by Brandes and by Péligot. It is produced by the decomposition by water of the neutral salt, or its solution in dilute sulphuric acid. Precipitated from a solution, I have found it amorphous, but by standing two or three days in contact with the liquid, it crystallises in needles. According to Brandes, the amorphous salt loses the greater part of its acid by washing with water. The neutral salt, or rather the magma to which the solution of oxide of anitimony in concentrated acid congeals on cooling, is resolved into minute crystalline needles, when decomposed by warm water, or when by the dilution of the acid sufficient heat is evolved. They subsided readily in the liquid, and could be boiled with repeated portions of water without changing their appearance, or the production of an amorphous substance. When brought upon a filter and washed copiously with boiling water, the filtrate contained constantly a little sulphuric acid, and deposited oxide of antimony on cooling. From the agreement of the result of their analysis with the calculated composition, it would seem that in the crystalline state, this salt is not decomposed, or is but slowly decomposed by hot water. 0·8334 of the salt prepared in this way, and dried by pressure in paper, gave 0·8393 SbS_3 and 0·2735 $BaOSO_3$.

	Calculated.	Found.
$2SbO_3$	85·66	86·52
SO_3	11·71	11·27
HO	2·63	(2·21)
	100·00	100·00

Brandes found in the salt 3 per cent of water. Péligot obtained it water free, and also with two atoms of water. Heated to 100° it lost one half per cent; the rest of the water required for its expulsion a temperature above 240°.

The series of the sulphates of antimony resembles those of the earths glucina and zirconia, considered as sesquioxides. The neutral sulphate of neither of these earths combines with hydrate of sulphuric acid to form an acid sulphate,* and the most basic compound of both contains two equivalents of base to one of acid. In place of a bisulphate, they have salts with three atoms of acid to two of the earths, and no intermediate salt, like that of antimony, has yet been discovered. From bismuth the antimony series differs in that the salts of the former metal are decomposed by water, according to Heinz and Ruge, into basic salts containing equal equivalents of acid and base; here, also, no immediate salt is yet known. A more important difference lies in the fact that oxide of bismuth appears to form one, if not two, acid sulphates. I have analyses indicating the existence of compounds of the neutral salt with three atoms of hydrate of sulphuric acid: and also of a salt crystallising in beautiful pearly scales, and containing equal equivalents of the neutral sulphates of bismuth and potash. A salt with three equivalents of sulphate of potash has been described by Heinz. The further account of these bodies must be reserved until their analyses have given more trustworthy results.—*American Journal of Science*, 1868.

* Zirconia, Berzelius, but perhaps not quite certain; glucina, Berzelius, and my own experiments.

THE SALT DEPOSITS AT STASSFURT.

By Messrs. BALD and MACTEAR.*

THE southern part of the North German Basin is divided by the Hartz into two portions, which are known as the Thuringian and the Magdeburg Halberstader basins, in which salt has been raised for a lengthened period in the form of brine.

The basin covers a surface of 120 English square miles, and is filled with new red sandstone, which is not broken up by any of the older formations. It is interspersed by elevations of gypsum, which is considered a certain indication of the presence of common salt. In the Prussian mine at Stassfurt, in the Magdeburg basin, after passing through 27 feet of alluvial soil, a thickness of 576 of new red sandstone is at once reached, then 213 feet of gypsum, anhydrite, and marl, the salt being found at a depth of 816 feet. In the Anhalt mine (half a mile from the Prussian one) the sandstone is entirely wanting, the salt bed being reached at a depth of 480 feet, after passing through 20 feet of soil and 460 feet of gypsum, anhydrite, and marl. The boreholes at Schonebeck (some miles from Stassfurt) show very distinctly the various strata with which the basin is filled up as the salts gradually get deeper and deeper. Thus, at bore No. 8, the salt is 1000 feet from the surface, the intervening strata being 200 feet of alluvial soil and 800 feet of new red sandstone. At No. 5 there is 37 feet of alluvial soil, 166 feet of mussel-chalk, and 1,277 feet of new red sandstone, the salt being 1,480 feet from the surface. At No. 6 there is 30 feet alluvial soil, 877 feet mussel-chalk, and 473 feet new red sandstone, the salt being 1,380 feet from the surface. At No. 4 there is 25 feet alluvial soil, 211 feet of what in Germany is called keuper and lettenkohle (literally, copper and letten coal). This keuper is the equivalent of the saliferous and gypseous shales and sandstones of Cheshire, a member of the "Irias" or new red sandstone formation. Lettenkohle is a variety of lignite known in the district as brown coal. Next we have 1,067 feet of mussel-chalk, 377 feet of new red sandstone, and the salt at a depth of 1,680 feet. Bore No. 3 is somewhat similar to No. 4, there being 30 feet alluvial soil, 435 feet keuper and lettenkohle, 1,087 mussel-chalk, 212 new red sandstone, the salt being 1,764 feet from the surface.

In the Magdeburg basin the salt rests on new red sandstone, and in the Thuringian basin on mussel-chalk and magnesian limestone.

It is only at Stassfurt and Erfurt that the salt is mined; at all the other places it is obtained by means of brine wells, the liquor from which is concentrated by the graduation process, which consists in allowing the weak liquor to trickle through walls made of bundles of thorns and brushwood.

The graduation houses consist of a timber framing, into which the faggots or thorns are built in regular walls. The structure is covered with a roof to protect it from the rain, but the sides, of course, are open to admit of the free passage of air, which, together with the solar heat, forms the evaporating medium.

The walls are from 30 to 50 feet high, and of immense length, the celebrated one at Schonebeck being fully more than an English mile in length. They are placed in the manner best suited to obtain the full benefit of the pre-

* Read before the Chemical Section of the Glasgow Philosophical Society, January 18, 1868.

vailing wind. The house is divided into several sections, and the weak liquor is pumped up into a cistern, from which it is led by means of a perforated pipe along the top of the first division, down the sides of which it trickles into a large wooden tank underneath. From this it is pumped up and allowed to trickle through the second division, from underneath which it is pumped on to the third, and so on until it reaches the last one. In graduation houses, where the number of compartments does not exceed three, and, indeed, in all of them, to a greater or less extent, the liquor is pumped through the same division several times. The weak brine at Schonebeck contains 7½ per cent of common salt, which, at the finish of the graduation process, is raised to about 22 per cent. In this state it is run into large tanks, of which there are eight at Schonebeck, of an aggregate capacity of about two and a half million gallons. From these tanks it is drawn off to the evaporating pans as required for boiling down. At these works the process of graduation can be carried on for an average of 250 days in the year.

The boring operations were commenced at Stassfurt on the 3rd April, 1839, and in June, 1843, had penetrated to the rock salt region. In January, 1851, when it had reached a depth of 1851 feet, the liquor from the bores contained—

Sulphate of magnesium	4·01
Chloride of magnesium	19·43
Chloride of potassium	2·24
Chloride of sodium	5·61
Total salts	31·29

However, in 1848, Professor Marchand gave it as his opinion that the salts were not mixed in the manner represented by the brine, but that pure rock salt would be found at the bottom with the more soluble salts overlying it; and so much weight was given to his opinion that in December, 1851, after having penetrated to a depth of just as many feet as there were then years in the Christian Era, the sinking of the shaft "Von der Heydt" was commenced, followed in January, 1852, by that of the shaft "Von Monteuffel;" and in 1856 the pure salt was found 1,066 feet from the surface.

The shaft passes through—1st, 27 feet of alluvial soil; 2nd, 576 feet of sandstone, with some schist and grey limestone; 3rd, 192 feet of gypsum and anhydrite; 4th, 21 feet of bituminous matter mixed with anhydrite and common salt—making in all 816 feet. Next there is 158 feet of abram or potash salts, the value of which was not recognised at first, but which now play a very important part in the industry of the country. The shaft then passes through 92 feet of rock salt, the upper portion of which is rather impure, being mixed to a considerable extent with anhydrite. This makes a total depth of 1,066 feet, and at this point the lateral workings were commenced. These consist of large galleries, the principal of which are from 40 to 60 feet broad, 20 to 25 feet in height, and about 200 feet long.

The salt is wrought in a manner somewhat similar to our long wall system, a series of holes of sufficient depth, about 6 feet or so, are drilled in the face of the salt about 5 feet from the floor, and this depth of material is removed by a series of small blasts. This operation is repeated until a considerable space has been cleared under the overhanging mass of salt. Bore-holes are then drilled close to the roof, and by a series of simultaneous blasts, a large mass of salt is dislodged. In one of those halls or galleries which we visited there was lying on the floor a mass of between two and three thousand tons which had been removed in this manner a few days previously. A number of boys are employed to pick out the pieces of pure salt, which only requires grinding to fit it for domestic use. The salt is removed to the pit bottom in hutches running upon rails, exactly similar to those in use in our own coal pits. From this they are lifted to the surface by an engine of 130 horse-power, and removed to the grinding mills, of which there are twelve at the mines. There is also a 200 horse-power engine for pumping, which lifts 13 cubic feet of water per minute.

The workings into the potash salts are opened on the other side of the shaft from the common salt galleries, for although the salts are deposited one on the top of the other, still as they dip at an angle of 30° they are all wrought from the one level.

The total thickness of the salts is 1,197 feet, and this may be said to consist of—

Rock salt	989 feet
Anhydrite	36 ,,
Polyhalite	13 ,,
Kieserite	51 ,,
Carnallite	98 ,,
Hydrated chloride of magnesium	13 ,,

This gives a composition of—

Chloride of sodium	85·82
Sulphate of calcium	4·88
Sulphate of magnesium	4·70
Sulphate of potassium	0·40
Chloride of magnesium	2·53
Chloride of potassium	1·67
	100·00

We will now consider the beds *seriatim*, beginning with the lowest, which is called the *anhydrite region*, and consists of 685 feet of pure rock salt interspersed with thin layers of anhydrite a quarter of an inch or so thick, and dividing the salt at intervals of from one to seven or eight inches. The salt is pure and colourless when pulverised.

The anhydrite is anhydrous sulphate of calcium, and contains a small quantity of a bituminous matter which imparts to it its char grey colour; traces of organic remains are also proved by the presence of a gas containing carburetted hydrogen which, according to Bischof, has the following composition:—

Carburetted hydrogen	85
Carbonic acid	3
Atmospheric air	12
	100

It is present in quantities of about 3 c.c. per kilogramme in the rock salt and about 8 c.c. in the kali salts. It presents the appearance of air bubbles in the transparent crystals. The specific gravity of anhydrite is 2·968, and it is soluble in water to the extent of 1 part in 500.

In the second or *polyhalite region* we have, besides the common salt and sulphate of lime, a deposition, from from what might be considered the mother liquors, of the sulphates of potassium and magnesium which have combined with the sulphate of calcium to form the salt polyhalite, from which this division takes its name; its composition is given on the table:—

$$2CaSO_4+MgSO_4+K_2SO_4+2H_2O.$$

It has a specific gravity of 2·720 and is immediately decomposed by water. Specimens of it are seldom found pure, as they generally contain from 2 to 6 per cent of chloride of sodium. This bed is about 200 feet thick, and has an average composition, according to Steinbeck, of—

Chloride of sodium	91·20
Anhydrite	0·66
Polyhalite	6·33
Hydrated chloride of magnesium	1·51

the upper layers, however, being the more impure.

In the third or *kieserite region* the gradual disappearance of the more insoluble salts is made manifest, for it contains on an average only 2 per cent of anhydrite, and about 60 per cent of common salt, and from 17 to 20 per

cent of kieserite, which is monohydrated sulphate of magnesium, the former being—$MgSO_4+H_2O$. Specimens found in the mine generally contain from 1 to 2 per cent of chloride of sodium or magnesium; it is amorphous, greyish white, and transparent, and in the air has a tendency to pass into epsoms, becoming opaque during the transformation; it is soluble in rather more than twice its weight of water (40·9 parts in 100 H_2O). When the quantity of water is not sufficient for complete solution this salt has the peculiar property of absorbing a certain quantity of it and setting into a hard mass, more resembling a piece of flint than anything else, and with, of course, a considerable increase of volume.

(To be continued).

ON THE

CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(Adapted to a Juvenile Auditory),

delivered at the

ROYAL INSTITUTION OF GREAT BRITAIN,

(CHRISTMAS, 1868-9),

by

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE III.

Air—Oxides—Carbon or Charcoal.

(Continued from page 52.)

Now, carbon may exist in two states—in that in which it will burn, and in that in which it is already burnt. All our ordinary combustibles contain charcoal, but many of them—almost all indeed—also contain another substance. We know, in fact, that these substances contain charcoal, because when they burn they give rise to burnt or oxidised charcoal—that is to say, to carbonic gas; but there is another combustible called hydrogen, which is the gas known as inflammable air, and when this hydrogen burns it produces oxide of hydrogen instead of oxide of carbon, and oxide of hydrogen is water. Here is the dry hydrogen gas burning, and here is the water which is being produced by its combustion, and when, by means of magnesium wire, I illuminate the jar, you see what a very beautiful appearance is presented by the drops of the water on the sides of the glass vessel in which the combustion of the hydrogen has been going on. Well, then, as I have said, when carbon burns we get carbonic gas or oxide of carbon, and when hydrogen burns we get water or moisture produced, that water being an oxide of hydrogen, and we recognise the presence of carbon or hydrogen in a combustible by the fact that, when burning, the one produces carbonic gas and the other water. Now, I will show you once again the production of this carbonic gas by the combustion of charcoal. We take our old test, the lime-water, and pour some of it into this glass; we then allow the air which has passed over the burning charcoal to bubble through the lime-water, and as carbonic gas is produced our lime-water turns milky. Now, instead of the current of air which we are using, we will turn a current of oxygen upon the burning charcoal, and you will see that it will then burn in a very different manner. [The experiment was performed, and the formation of carbonic gas by the combustion of the charcoal in oxygen was indicated by the clouding of the lime-water.] In this way you see that, whether we burn charcoal in oxygen or in air, the production of carbonic gas accompanies the burning.

Now let us turn our attention to some ordinary combustibles. We will first burn some ordinary coal gas from this burner, and notice what products our coal gas will furnish. To begin, we will take a bottle at present containing nothing but air, and hold it over our flame; now notice what takes place. You will first of all see that the interior of the vessel very quickly becomes dimmed or dewed with a film of water. Accordingly, coal gas by its burning produces water or oxide of hydrogen; hence we learn that the unburnt coal gas contains hydrogen. Now, does the burning of coal gas also produce carbonic acid? We shall very soon ascertain this by pouring into the bottle some lime-water, shaking it up for a minute or two, and then observing whether we convert our clear dissolved lime into insoluble chalk. [The lime-water test was applied as described.] You see that in this case chalk is produced, which shows that our coal gas contains charcoal.

As we have talked about coal gas in this way, I ought to call your attention to the manner of collecting it, and show you what sort of a substance it looks like when we get it in something like a definite quantity. I have a tube attached to the gas pipes, and from the end of this, which is under water, you see it is bubbling up, and is quite invisible. In a minute or two a jar full will be collected. It has all the appearance of ordinary air; it is quite invisible, and nobody can tell from its appearance that it contains charcoal any more than you could tell that the atmospheric air by which we are surrounded does so. Our cylinder is now filled with this ordinary coal gas, and we will proceed to set fire to it. You see the very rapid manner in which coal gas burns when it is ignited in this way.

We will next see how a candle behaves when burnt in a current of oxygen; and now I am going to call your attention to a somewhat

* Reported verbatim, by permission of the Author, for this Journal.

different phenomenon. We place a lighted candle in this glass vessel and then turn on the oxygen; the candle is now burning in a current of oxygen. Whilst it is doing so, I will cut off the supply of the ordinary air, which is also being admitted to the vessel; but you see that this does not matter in the least while the candle is supplied with a current of oxygen gas. When, however, I remove the current of oxygen, and allow the candle to burn by the aid of the ordinary air, you see a great difference; it burns very dimly, and also smokes, and in the course of a minute or two it will go out. Now how is it that the candle smokes in this way? We can make coal gas do the same, and all that we have to do to produce this effect is to treat it much in the same way—to cut off the supply of air. If we do this we find that the coal gas also will smoke. Here it is burning in the ordinary way, and now if I bring down a piece of wire gauze upon it, and cut off the supply of air thus, you observe that we get a very considerable amount of smoke.

Now, how is it that when the supply of air is cut off the burning candle and coal gas both deposit their carbon in the form of charcoal instead of yielding it in the shape of carbonic gas? Well, I will just direct your attention to the manner in which these ordinary combustibles burn in another gas, namely, chlorine—this green air, one of the properties of which is that while hydrogen burns in it very readily, carbon or charcoal does not burn in it at all, and, accordingly, if we introduce a lighted taper into it, the hydrogen of the taper burns readily, but the carbon of the taper will not burn, and therefore the flame smokes very much. You see the taper continues burning when it is introduced into the gas, but the carbon which will not burn is liberated, and appears in the form of smoke instead of being converted into invisible carbonic gas. Here is a jar containing some chlorine, to which I will add some of the coal gas, and we will now set fire to the mixture. [A light was applied to the jar, and the mixture exploded with a sharp detonation.] You see the very vigorous manner in which the coal gas burns in chlorine; but you will also observe that the sides of the jar are covered with an abundant deposit of unburnt charcoal. When these *hydrocarbon* substances burn in a sufficient supply of air, both the carbon and the hydrogen burn. The hydrogen is converted into water and the carbon into carbonic gas; but when these substances burn in chlorine instead of in air, only the hydrogen burns, and the carbon, instead of passing into the burnt condition and becoming carbonic gas, makes its appearance in the unburnt condition of soot.

Again, if instead of burning the candle or the coal gas with a sufficient supply of air, we burn it with an insufficient quantity, the oxygen takes the hydrogen in preference, and this alone burns, the carbon being deposited without combustion. When we were burning this candle in oxygen both the hydrogen and the carbon burned, and there was no deposit of soot or charcoal; but when the charcoal burned in an insufficient supply of air, the hydrogen and carbon could not both undergo combustion: either the hydrogen alone must burn or the carbon alone, and the former did so in preference to the latter. Now, it is in this way that we generally obtain charcoal. Instead of burning the pieces of wood or materials from which charcoal is derived, with a sufficient supply of air, we burn them in an insufficient quantity, and, in that case, the hydrogen undergoes combustion, and the carbon is left unburnt. Some very beautiful forms are frequently obtained in this process. Here is some straw which was burnt in the manner I have described. The hydrogen has been consumed, and the charcoal of the straw remains in this beautiful form. Here, again, are some nuts and kernels of fruit which have been burnt into charcoal, and in the same way we obtain wood charcoal and the numerous varieties of this substance which are familiar to us. Sufficient air to burn the hydrogen is admitted, but there is not enough to combine with the carbon, and thus we get it in a separate state. There is another way in which charcoal may be obtained. At a sufficiently high temperature the hydrogen separates from the carbon without burning, and this furnishes us with another means of obtaining charcoal. In consequence of the heat which we applied to the tube of porcelain to which I drew your attention in the early part of the lecture, the coal gas which has been passing through the tube has deposited a large quantity of charcoal on the white porcelain.

So much for the methods of obtaining charcoal. We must now pass on to the consideration of some of the properties of charcoal, and the most remarkable is its extreme porosity. An ordinary piece of this substance, such as that lying on the table, has the singular property of being able to absorb very many times its volume of gas or air, and accordingly we find that what looks like a piece of charcoal, pure and simple, contains many times its own bulk of air. I can show you this by means of the air-pump. If we place some charcoal in water under the glass of the pump, and then exhaust the air, you will see bubbles of air given off. Here we have a piece of charcoal buried under water, and on working the pump we can extract the air contained in the charcoal. [The piece of charcoal was subjected to the experiment described, and gave rise to an abundant stream of bubbles when the pump was worked.] You see the large

quantity of air which has been taken up by this piece of charcoal.

Now charcoal does not absorb all kinds of air with the same facility, but it absorbs some kinds far more readily than others. Here is a table showing you the absorption which one kind of charcoal will effect in respect to different gases :—

ABSORPTIONS OF GAS BY 1 CUBIC INCH OF COCOA-NUT SHELL CHARCOAL.

Oxygen	18 cubic inches
Carbonic gas	68 ,,
Sulphuretted hydrogen ..	100 ,,
Ammonia gas	170 ,,

A cubic inch of charcoal will absorb various quantities of different sorts of gas ; but some kinds of charcoal absorb gas far more readily than others, and this is particularly the case with that obtained from the shell of the ordinary cocoa-nut. Let us consider what is the amount of gas which this form of charcoal will absorb. A cubic inch of the cocoa-nut shell charcoal can absorb 18 cubic inches of oxygen ; it is, in fact, capable of absorbing the quantity of oxygen represented by this block. [The lecturer here took a piece of charcoal 1 cubic inch in size, and placed upon it a rod of deal, 1 inch square and 18 inches long. In the subsequent illustrations, rods 68 inches, 100 inches, and 170 inches long respectively, were employed to illustrate the quantities of carbonic gas, sulphuretted hydrogen, and ammonia gas absorbed by 1 cubic inch of charcoal.] Now you can scarcely form any idea of the amount of force which is required for that absorption. If we were to take 2 cubic inches of oxygen, and endeavour to compress them into the space of one, we should require the pressure of 15 lbs. weight ; but to compress 18 cubic inches of oxygen into the space of 1 cubic inch, we should require eighteen times 15 lbs., which would be equivalent to about two hundredweights and a half. Here is a half hundredweight, and it is almost as much as I can lift. Now we should require about five such half hundredweights to compress 18 cubic inches of oxygen into the space of 1 cubic inch ; but you must observe that the cubic inch of charcoal which can absorb these 18 cubic inches of oxygen, appears to be already full of the substance of the charcoal itself. There seems to be scarcely any space left ; and what gas the charcoal will contain must occupy its pores. Now, if we imagine that the pores occupy even as much as a twentieth part of the whole mass, we should then require, not five times, but about one hundred times the pressure of this half hundredweight, to compress 18 cubic inches of oxygen into a cubic inch of charcoal. Nevertheless, so great is the absorptive power of this kind of charcoal that it gradually exerts upon the oxygen a compressing effect equal to the force of some 50 hundredweights.

With regard to carbonic gas, it has been found that a cubic inch of charcoal is capable of absorbing 68 cubic inches of carbonic gas, or the quantity represented by this rod [placing a rod 68 inches long on the cubic inch of charcoal]. Lastly, there are two gases which are the result of the decomposition of animal matter. When animals undergo decomposition they emit two kinds of gas—one called sulphuretted hydrogen, the other ammonia. Now charcoal has the property of fixing these two gases with still greater facility ; and accordingly our 1 cubic inch of charcoal can absorb 100 cubic inches of sulphuretted hydrogen gas, or the quantity which is represented by this rod. And with ammonia gas, the power of absorption is even more striking : 1 cubic inch of charcoal is able to absorb 170 cubic inches of ammonia, or the quantity represented by this other rod. And you must remember that these gases are not compressed into only 1 cubic inch of space, but into the small pores or interspaces contained in the charcoal, which seems to be solid. Thus you may form some idea of the immense force which charcoal is capable of exerting in this way.

Let me give you one or two illustrations of this property. I have, in this tube, some ammonia gas, and into this ammonia gas I will put a piece of charcoal. This is placed over mercury, and you will see that after a little while, the charcoal will gradually rise up in the tube, so as to absorb the whole of the gas, and the mercury will follow it, until the tube becomes completely full.

It is upon this remarkable absorption of different gases by charcoal that the efficacy of this substance as a respirator or ventilator depends, for it is found that when these gases are absorbed into charcoal, they have the property of acting upon one another with considerably increased activity. A striking illustration of this is afforded by the following experiment :—Here we have a glass jar, in the lower part of which is a partridge,—and I am afraid to tell you how long that partridge has been there, but at this time it is in anything but a pleasant condition. On the top of the jar is a piece of iron trellis, and on that trellis is placed some charcoal. If any one who is curious will try to smell the partridge through the charcoal he will utterly fail to detect any odour ; but not only are the offensive emanations given off from the partridge—the sulphuretted hydrogen and ammonia—wholly absorbed by the charcoal, but it also absorbs the oxygen gas from the air, and these gases—the oxygen of the air, the sulphuretted hydrogen, and ammonia—at once react upon one another. The gases arising from the

partridge become burned or destroyed through the presence of the oxygen, and accordingly this action would go on for any length of time. Now, for the accommodation of any one who is still curious, there is an opening closed with a cork in the side of the jar underneath the charcoal, and if he wishes to ascertain the difference between the gases before they pass through the charcoal and after they have done so there is an opportunity for him to gratify his curiosity.

The same kind of action which enables charcoal to behave so excellently as a purifying substance, also renders it valuable as a decolourising agent. Here we have two columns of charcoal—the charcoal obtained from bone—and I want to call your attention to the decolourising effect it will produce. We have here two coloured liquids which we will pass through these columns of charcoal, and in order that you may see what change takes place, we will take two glasses of each liquid, and reserve one glass of each to enable you to see what change is produced in the liquids by their passage through the charcoal. One of these liquids is blue indigo, and the other cochineal. We will now pour one glass of each slowly through the charcoal, for the decolourising action is one which, like the absorption of the ammonia gas, takes a little time for its accomplishment. The result will be, either that the colour will entirely go, or will be diminished to such a degree that you will see a very great difference in the appearance of the liquids as they run out of the charcoal. [The filtered liquids, after passing through the charcoal, were exhibited to the audience, and found to be deprived of their colour by the filtration.]

Now, in the minute or two that remains to me I will direct your attention to the use of charcoal in charcoal filters. You see on the table two glasses of water; one of these is the water supplied to this Institution. This is, perhaps, hardly a fair sample, because, after these heavy rains, it is far more impure than usual. Here is some of the same water after it has passed through this filter, which is filled with animal charcoal, much in the same way as those in which we filtered the coloured liquids. Here are specimens of filtered and unfiltered water, and they are so placed that you can see with one eye through each tube at the same time.

On the Desulphuration of Chemical Combinations.—In this research the properties of hexanilide and its compounds with chlorhydric, nitric, sulphuric, and oxalic acids, and the analogous compounds of hexatoluide derived from toluide are examined and completed. These bodies proceed from the desulphuration of sulphocarbonilide and of sulphotoluide. The authors have also observed the action of nascent hydrogen upon these substances. The final product is aniline with the first body and of toluidine with the second. The sulphocyanogen or sulphocyanide of potassium produces sulphoretted hydrogen and methylamine.—*Société. de Pittig.*

PROCEEDINGS OF SOCIETIES.

NEWCASTLE CHEMICAL SOCIETY.

THE second general meeting was held in the rooms of the Literary and Philosophical Society, on January 28th, and was numerously attended. In the absence of the President, the chair was occupied by John Glover, Esq.

The names of eight new members were read for the first time.

Mr. JOHN PATTINSON read a note "*On the Relation between English and Foreign Alkalimetrical and Chlorimetrical Degrees.*"

In the discussion which followed, the general feeling seemed to be that 23 should be substituted for the various incorrect values employed for sodium in some laboratories.

Mr. R. C. CLAPHAM read a paper entitled "*Some Account of the Origin of the Soda Trade on the Tyne.*"

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Conversion of Organic Chlorides into Iodides.—A. Lieben.—Organic chlorides are converted into iodides by the action of concentrated iodhydric acid. This method of conversion seems to be a general one, and subject to limitation only in so far as some iodides at the moment of their formation are converted into hydride. Ethyl chloride, at 130° C., is almost completely converted into iodide, without evolution of gas or formation of any by-product. The same is the case with butyl and amyl chloride. Chloroform is converted into methylene di-iodide according to the following equations:—

1. $CHCl_3 + 3HI = CHI_3 + 3HCl$.
2. $CHI_3 + HI = CH_2I_2 + I_2$.

—(*Akad. z. Wein*, 58, 1868.

Guanidine from Chloropicrin.—A. W. Hofmann.—Guanidine may be readily prepared in large quantities by heating chloropicrin, with a strong alcoholic solution of ammonia, to 100° C. for several hours, and extracting the mixture of salts thus obtained with absolute alcohol. Guanidine nitrate, $CH_5N_3HNO_3$, is precipitated as a crystalline powder by adding to the chlorhydrate a solution of potassium nitrate. It forms with silver nitrate the compound $CH_5N_3.AgNO_3$; the chlorhydrate gives with gold trichloride, $CH_5N_3HCl.AuCl_3$. Dry guanidine chlorhydrate dissolves in aniline; on heating the solution, ammonia is given off, and the residue contains a compound of the composition of, but differing from, melaniline, $CH_3(C_6H_5)_2N_3$.—(*Deut. Chem. Ges. Berlin*, 145, 1868.)

Sulphuric Acid and Ethyl Sulphocyanate.—Schmitt and Glutz.—On acting upon ethyl sulphocyanate (1 vol.) with concentrated sulphuric acid (2 vols.) a violent disengagement of carbonic anhydride takes place, and a compound is formed which is isomeric with ethyle xanthate. To obtain it, the products of the reaction are mixed with water and distilled, when it goes over together with water as a heavy oil of the composition $C_5H_{10}S_2O$. It has the smell of garlic, is insoluble in water, soluble in alcohol, ether, and strong sulphuric acid. It boils at 196—197°C. Its formation is shown by the following equation:—

$$2(C_2H_5SCN) + 3H_2O + 2(H_2SO_4) = C_5H_{10}S_2O + 2(HNH_4SO_4) + CO_2.$$

The new compound gives with alcoholic potassium hydrate—potassium carbonate and mercaptan; with alcoholic ammonia—urea and mercaptan; with water at 160°—carbonic anhydride and mercaptan. The con-

stitutional difference between it and its isomer is represented in the following two formulæ :—

Ethyl xanthate .. .. $\mathrm{CS}\begin{cases}\mathrm{SC_2H_5}\\ \mathrm{OC_2H_5}\end{cases}$

New compound, or carbonyle-disulphodiethyle $\mathrm{CO}\begin{cases}\mathrm{SC_2H_5}\\ \mathrm{SC_2H_5}\end{cases}$

The authors have in a similar manner prepared the corresponding methyl and amyl compounds; they boil at 169° and 281° respectively. The reaction in the cases of allyle sulphocyanide and ethylene sulphocyanide seems to be of a different nature.—(*Ibid.*, 166, 1868.)

Aldehydine.—E. Ador and A. Baeyer.—If aldehyde-ammonia, urea, and ammonium acetate are heated together to 120°—130° C., and oil of the composition $\mathrm{NC_9H_{11}}$ = aldehydine is obtained. It floats upon water, in which it is slightly soluble; its boiling point is 175°. It smells like conine, from which it differs in composition by a minus of $\mathrm{H_4}$; it cannot, however, be converted into the latter by the action of sodium amalgam. With chlorhydric acid, aldehydine forms a crystalline salt. The following equation illustrates the mode of its formation :—

$$4\mathrm{CH_3CH(NH_2)(OH)} = \mathrm{NC_9H_{11}} + 3\mathrm{NH_3} + 4\mathrm{H_2O}.$$

—(*Ibid.*, 189, 1868.)

Derivatives of Hippuric Acid.—P. Griess.—1. *Oxyhippuric acid*, $\mathrm{C_9H_9NO_4}$, is formed by boiling an aqueous solution of sulphuric-diazohippuric acid. When the evolution of nitrogen has ceased, the acid solution is neutralised with ammonia, evaporated on the water-bath, and the acid liberated by adding chlorhydric acid. It crystallises in needles, and is readily soluble in hot water, alcohol, and ether, sparingly in cold water. 2. *Iodhippuric Acid* is prepared by the action of aqueous iodhydric acid upon sulphuric-diazohippuric acid. The raw product is dissolved in ammonia, decoloured by means of animal charcoal, and precipitated with chlorhydric acid. The acid is soluble in alcohol, moderately soluble in hot water. On re-crystallisation it is obtained in large leafy crystals resembling naphthaline. Its constitution is represented by the formula $\mathrm{C_2H_2(NH_2)O_2.C_7H_4IO}$; that of Maier's iodhippuric acid with which the former is isomeric, $\mathrm{C_2HI.NH_2O_2.C_7H_5O}$. —(*Ibid.*, 190, 1868).

New Bases.—P. Griess.—Amongst the products of dry distillation of cyan-amidobenzoic acid—

$$(\mathrm{C_7H_5[NH_2]O_2.\,_2CN})$$

is an oil of basic properties. After purification it crystallises in needles which fuse at 53° C., and can be distilled without decomposition. The composition of the base is $\mathrm{C_7H_6N_2}$, and it forms well-defined salts. Another base, of the composition $\mathrm{C_{16}H_{18}N_4O_6 + 2H_2O}$, may be obtained from $\mathrm{C_7H_5(NH_2)O_2.2CN}$ by boiling with a strong solution of potassium hydrate or chlorhydric acid. It crystallises with two molecules of water, which escape at 120° C., and it cannot be distilled without decomposition. It dissolves in aqueous potassium hydrate, and is precipitated therefrom by carbonic anhydride; its salts are crystalline. This base may be considered to be composed of two atoms of amidobenzoic acid and one atom of oxamide—

$$2\mathrm{C_7H_7NO_2} + \mathrm{C_2O_2(NH_2)_2},$$

but it cannot be resolved into these constituents by boiling with acids or bases.—(*Ibid.*, 191, 1868).

CORRESPONDENCE.

OLEOGRAPHS.

To the Editor of the Chemical News.

SIR,—May I be permitted to reply to Mr. Tomlinson's courteous letter in your last issue, respecting our oleographs. Mr. Tomlinson says he cannot speak favourably of the impressions I sent him as types of cohesion figures. The oleographs I transmitted to him, and also to yourself and many others, were patterns of three or four different oils taken at random, little or no attention being paid to the time to which the oils were exposed on the water; I simply desired to show what could be done by this beautiful process. Mr. Tomlinson says that "there is a moment in the existence of every film when the characteristic figure is presented, by which it can be recognised and the purity tested." I can truly aver that such is the case, and also that our process of oleography is capable of receiving the perfect figure at the right moment and in an instant. The oleographic process needs only to be tried by any one to shew its capabilities in this way. Lard, tallow, linseed, and many other oils, produce patterns, when placed on water which there is no mistaking. Some oils develope their figures in a few seconds after they are placed on the water, and the paper we use will take up the pattern at once; so that by taking impressions of the same oil at different lengths of time, we have a series of oleographs produced which are of the greatest value in determining the purity of the oil. I am most desirous of enforcing that the period of time taken to produce a given pattern is an indispensable element in the proper testing of any oil.

Now when I set about the examination of any oil, I arrange six plates of water and let fall a drop on each, most accurately taking the time of exposure, and fixing the various patterns, so that I now have the oil in all its stages of development. For instance, take off the patterns every ten seconds up to three minutes, or beyond that time if necessary, as there are some oils which take a long time to develop their distinguishing design. Now compare these fixed patterns with those of any other oil taken under exactly similar circumstances, and the value of the test is at once manifest. Oleography is a process for fixing the patterns of oils, and thereby rendering them available for comparison.

Mr. Tomlinson appears to work much with oils of little commercial interest, as coriander, lavender, &c. Oil merchants are not as a rule interested in these oils; the oils of sperm, rape, linseed, lard, tallow, olive, cotton, and their adulterations chiefly engage their attention. In oleography we have a certain means of estimating their genuineness and in many cases their adulterants. Respecting the *colours* of the oil films I am almost sure no one will be ever be able to make anything of, as they are simply, I believe, the result of a property of the oil to decompose light.

For the value of oleography as a test for oils I would respectfully ask the opinion of those who are now engaged in working out results. At the request of a number of oil merchants here we are issuing an "Oleographic Album," containing the authentic oleographs of any oils desired and made by myself in the laboratory.

Some little time ago I asked a public opinion from Mr. Tomlinson regarding this process of oleography as a test for oils, and for his kindly doing so I beg heartily to thank him.—I am, &c.,

R. CARTER MOFFAT, Ph.D.

Laboratory, Mechanics' Institution, Glasgow,
Feb. 4th, 1869.

UNIFORMITY IN TAKING "IGNITING POINTS."

To the Editor of the Chemical News.

Sir,—Icordially subscribe to Mr. Hutton's remarks on the above subject in your late issue :—"Without a uniform method no two results will agree; but with a recognised method both manufacturers and merchants would know what the igniting point of the vapour of commercial substances exactly means, and a security to consumers and others that does not now exist would be obtained." Public attention having of late years been much directed to the danger attending the transit, storage, and employment of oils, spirits, and other inflammable materials, it is highly desirable that all chemists should adopt some

conventional method of determining the degree at which indefinite volatile liquids give off vapour sufficiently fast to afford a distinct flash on the approach of flame—*the igniting point, firing point, or flashing point.* Now the Petroleum Act, which came into full operation on February 1st, contains a schedule wholly devoted to "Directions for applying the flashing test to samples of petroleum oil;" this method was drawn up by Professors Abel, Letheby, and myself, is the only recognised legal process, and is, therefore, I submit, the one which should be adopted by chemists in ascertaining the firing point of liquids other than petroleum.*

In taking the flashing points of fixed oils for the Fire Offices, my colleagues, Professors Roscoe and Penny, and I employ a porcelain crucible, similar in size and shape to the test-vessel described in the Petroleum Act, and adopt the important precaution of protecting the stem of the thermometer employed by an outer glass tube; we thus arrive at tolerably concordant results.

I have appended the schedule of the new Act, as I believe it has not yet been printed in your journal. With regard to the Act itself it may be as well to observe that in the eye of the law petroleum is not petroleum if its legal flashing point is above 100° F., and no license is necessary for its sale or storage; while all mineral spirits or oils are, legally, petroleum if their flashing point is below 100° F. Traders in the latter must hold a license from one of the authorities mentioned in the Petroleum Act of 1862, and must label bottles and other vessels containing the liquid with the precautionary words mentioned in the 5th section of the Act of 1868.—I am, &c.,

John Attfield.

"Schedule.

"*Directions for applying the Flashing Test to Samples of Petroleum Oil.*—The vessel which is to hold the oil shall be of thin sheet iron; it shall be two inches deep and two inches wide at the opening, tapering slightly towards the bottom; it shall have a flat rim, with a raised edge one quarter of an inch high round the top; it shall be supported by this rim in a tin vessel four inches and a half deep and four and a half inches in diameter; it shall also have a thin wire stretched across the opening, which wire shall be so fixed to the edge of the vessel that it shall be a quarter of an inch above the surface of the flat rim. The thermometer to be used shall have a round bulb about half an inch in diameter, and is to be graduated upon the scale of Fahrenheit, every ten degrees occupying not less than half an inch upon the scale.

"The inner vessel shall be filled with the petroleum to be tested, but care must be taken that the liquid does not cover the flat rim. The outer vessel shall be filled with cold, or nearly cold, water; a small flame shall be applied to the bottom of the outer vessel, and the thermometer shall be inserted into the oil so that the bulb shall be immersed about one and a half inches beneath the surface. A screen of pasteboard or wood shall be placed round the apparatus, and shall be of such dimensions as to surround it about two-thirds, and to reach several inches above the level of the vessels.

"When heat has been applied to the water until the thermometer has risen to abont 90° Fahrenheit, a very small flame shall be quickly passed across the surface of the oil on a level with the wire. If no pale blue flicker or flash is produced, the application of the flame is to be repeated for every rise of two or three degrees in the thermometer. When the flashing point has been noted, the test shall be repeated with a fresh sample of the oil, using cold, or nearly cold, water as before; withdrawing the source of heat from the outer vessel when the temperature approaches that noted in the first experiment, and applying the flame test at every rise of two degrees in the thermometer."

* The apparatus may be obtained at Casella's.

ESTIMATION OF PHOSPHORUS IN IRON AND STEEL.

To the Editor of the Chemical News.

Sir,—I read with some surprise in your account of the "Proceedings of the Chemical Society" on Thursday, January 21, an observation by Dr. Miller that "the old method of estimating phosphorus (in iron and steel), which involved the throwing it down as iron-salt, was unreliable."

For many years I have been in the habit of using this method, which I regard as quite as accurate as the phospho-molybdate process of Eggertz and not nearly so tedious.

I am constantly engaged in the determination of phosphorus and phosphoric acid in iron and iron ores; every process that has been recommended has been submitted by me to the most careful examination, and I have rejected all in favour of the old plan, which, I am confident will, if carefully executed, satisfy the requirements of the most fastidious chemist.

Among the precautions necessary to insure accuracy when dealing with iron and steel containing very small amounts of phosphorus may be mentioned that of not operating on too bulky solutions. When estimating phosphorus in iron and steel, I work on from 75 to 100 grains, and the solution, at the time of adding the tartaric (or citric) acid, ammonia, and sulphate of magnesia, is never allowed to exceed in volume 3 fluid ounces. The first precipitate always carries down a little iron, which is removed by re-solution and re-precipitation after the addition of a fresh small quantity of tartaric acid. I never collect the first precipitate till after the liquid has stood for twenty-four hours; the second precipitate is quite white, and may be filtered off after half an hour, and I am quite confident, from very long experience, that it contains the whole of the phosphoric acid. I have recently been using this method in cases where the amount of phosphorus has not exceeded 0·02 per cent.

I do not say that the phosphate of iron process is superior in point of accuracy to the phospho-molybdate process, but I do assert that it is quite as trustworthy and far less troublesome.—I am, &c.,

Henry M. Noad.

St. George's Hospital,
Feb. 1, 1869.

MISCELLANEOUS.

Optical Glass.—Messrs. Chance are now making optical glass of a density of 4·4.

Testing of Glycerin for Sugar and Dextrin.—To 5 drops of the glycerin to be tested add 100 to 120 drops of water, 3 to 4 centigrammes of ammonium molybdate, 1 drop of pure nitric acid (25 per cent), and boil for about a minute and a half. If any sugar or dextrin is present the mixture assumes a deep blue colour.—(*Polyt. Notitzbl.*, 143, 1868).

New Alkaloid in Fermented Liquors.—According to M. Oser, every time that solutions of sugar ferment under the influence of yeast, besides alcohol, a new alkaloid is produced, to which the author attributes the formula, $C_{26}H_{20}N_4$. The chlorhydrate of this base crystallises in hygroscopic tables, which become brown on exposure to the air. It appears that all fermented liquors contain the new alkaloid, or at least one of its compounds. We await further information on this subject; the presence of such a substance in wine and in beer, till now entirely unknown, will doubtless explain certain effects of fermented liquors on the animal economy, effects which cannot be attributable to alcohol alone.—*Cosmos.*

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News." A more complete list containing the omitted papers and contents of journals devoted to other branches of science, is published at the Patent Office, in the library of which the periodicals themselves may be consulted).

Comptes Rendus.

November 9, 1868.

A. W. Hofmann, "On the Compounds Isomeric with the Sulphocyanic Ethers: Homologues and Analogues of Oil of Mustard of the Ethylic Series." Secchi, "Note on Solar Protuberances." Jamin, "On the theory of Scintillation." Chevreul, on the same subject. Fizeau, "Note on A. J. Angström's 'Maps of the Solar Spectrum.'" J. N. Lockyer, "Further Remarks on the Author's Method of obtaining Spectra of the Solar Protuberances." F. M. Raoult, "On the Effect of a Rise in Temperature on the Calorific Phenomena accompanying Electrolysis." Berthelot, "On the Pyrogenous Formation of the Acetylene of the Benzol Series." Lefranc, "On Atractylic Acid and the Atractylates, some new Products extracted from *Atractylis gummifera*. G. Fleury, "A method of Preparing Emetics and other Double Tartrates." A. Commaille, "On the Presence of Creatine in Putrefied Whey."

November 16, 1868.

A. W. Hofmann, "On the Compounds Isomeric with the Sulphocyanic Ethers:—Comparison of the Metamorphoses of Oils of Mustard and of the Sulphocyanic Ethers." Warren de la Rue, "Note on a Photograph of the Sun." A. Scheurer-Kestner and C. Meunier, "Researches on the Combustion of Coal." (Continuation.)

Bulletin de l'Académie Royale de Belgique. (Classes des Sciences.)

October 10, 1868.

Stas, "Report on B. Radziszewski's Memoir on some Derivatives of Phenyl-Acetic Acid." B. Radziszewski, "Reearches on some Derivatives of Phenyl-Acetic Acid. C. Blas, "On the Fluorescent and other Properties of Murrayine, a new Glucoside obtained from *Murraya exotica*."

Poggendorff's *Annalen der Physik.*

October 12, 1868.

C. Pape, "On the Thermical and Chemical Axes of Gypsum and Sulphate of Copper." E. Warburo, "Observations on the Influence of Temperature on Electrolysis." W. Beetz, "On the Electric Vibration-Chronoscope." Pincus, "On a New Constant Voltaic Battery." A. Wullner, "A Method of obtaining an Artificial Spectrum with a single Fraunhofer's Line."

NOTES AND QUERIES.

The New Petroleum Act.—Can any of the numerous correspondents of the Chemical News tell us if benzol comes under the operation of the act. If it does, it will affect us rather seriously. We presume ether is not included.—A Wholesale Firm.

Manufacture of Iron.—A new process for the manufacture of iron, whereby the puddling process is obviated, is now on its trial at Pittsburgh, U.S. The pigs of crude iron are melted, and while in a fused state, a quantity of crushed ore is intermixed. The oxygen of the ore combines with the carbon of the iron; the mixed mass is called a pig bloom. Upon re-heating these pigs and squeezing them in the usual manner, iron of very good quality is obtained.—*Engineer.*

Chromium Steel.—It has long been known that an alloy composed of sixty parts of chromium and forty parts of iron is so hard as to scratch glass like a diamond, and such an alloy may be formed by heating oxide of chromium and also chrome iron ore in a blast furnace; if the oxide alone be applied, metallic iron, of course, should be added. Experiments on the large scale are now being carried on to produce a species of steel, suitable for rails and other purposes, by adding chrome ore and manganese to the iron in the puddling furnace. —*Engineering.*

Colouring Zinc.—Zinc may be given a fine black colour by cleaning its surface with sand and dilute sulphuric acid, and then immersing it for an instant in a solution composed of four parts of sulphate of nickel and ammonia in forty parts of water acidulated with one part of sulphuric acid, next washing and drying it. The black coating adheres firmly, and takes a bronze colour under the burnisher. Brass may be stained black with a liquid containing two parts arsenious acid, four of hydrochloric acid, one of sulphuric acid, and eighty of water.

Preservation of Wood.—According to statements made by Dr Feuchtwanger, of New York, who for the past thirty-six years has had his attention directed to the preservation of wood from every species of decay, and also to make it incombustible or fire-proof, not one single process attempted for this purpose has been attended with permanent success, except the application of silicates in their various forms to all organic substances, such as woody fibre, pasteboard, &c. Dr. Feuchtwanger's method is simply to steam the timber, then inject a solution of silicate of soda for eight hours, and then soak the wood for the same period in lime-water.

The Specific Gravity of Steel oxillates between 7·2 and 7·9. The hardening of the metal by tempering is accompanied, as Réaumur long ago observed, by a notable diminution of specific gravity, and Caron has noted that the specific gravity of steel diminishes with the number of times it is tempered.

MEETINGS FOR THE WEEK.

Monday, 8th.—Medical, 8.
—— London Institution, 8.
Tuesday, 9th.—Royal Institution, 3. Mr. Westmacott, "On Fine Art."
—— Photographic, anniversary, 8.
Wednesday, 10th.—Society of Arts, 8.
—— Geological, 8. E. Hull, Esq., B.A., F.G.S., "On a Ridge of Lower Carboniferous Rocks crossing the Plain of Cheshire." Rev. T. Wiltshire, M.A., F.G.S., "On the Red Chalk of Hunstanton." W. Boyd Dawkins, Esq., M.A., F.G.S., "On the British Postglacial Mammalia."
—— Microscopical, anniversary, 8.
Thursday, 11th.—Royal Institution, 3. Dr. M. Foster, "On the Involuntary Movements of Animals."
—— London Institution, 6
—— Royal, 8.30.
—— Zoological, 8.30.
—— Royal Society Club, 6.
Friday, 12th.—Royal Institution, 8. Colonel Drummond Jervoise, "On the Coast Defences of England."
—— Astronomical, 8; anniversary, 3 p.m.
Saturday, 13th.—Royal Institution, 3. Dr. Odling, F.R.S., "On Hydrogen and its Analogues."

TO CORRESPONDENTS.

*** Vol. XVIII. of The Chemical News, containing a copious index, is now ready, price 11*s.*, by post, 11*s.* 6*d.*, handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1*s.* 6*d.* Subscribers may have their copies bound for 2*s.* 6*d.* if sent to our office, or, if accompanied by a cloth case, for 1*s.* Subscribers wishing to complete their sets of volumes, are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xix. commenced on January 1st, and will be complete in twenty-six numbers. It will contain a verbatim report of Dr. Odling's Juvenile Lectures at the Royal Institution "On the Chemical Changes of Carbon," and original papers from some of our leading English and Foreign Chemists and Physicists.

Reprints of our Early Numbers.—In deference to the wishes of numerous subscribers, we have decided to re-issue many of our earlier numbers which have long been out of print, and in this manner we shall shortly be able to supply all the earlier volumes. No. 3, December 24, 1859, will be ready for issue in about a week's time.

A. W. A.—We cannot recommend any particular chemist in this column. Send a private address, with particulars, and we will communicate with you.

W. Cass.—The whole of the information you require respecting the best and most modern works on iron, its nature and working, &c., will be found in the second volume of Kerl's "Metallurgy," which will be published in the course of a month or two by Messrs. Longmans.

Phosphoric Acid.—A correspondent who makes some remarks on this subject, is informed that his letter is so badly written as to be almost unintelligible. The signature is hopelessly involved in flourishes, and it is only here and there that a word can be deciphered.

F. D.—Beside the works quoted last week, there are several others, chiefly in the German language, giving descriptions of laboratories. There are, for instance, descriptions of the laboratories of Giessen, Carlsruhe, Prague, Upsala, Dorpat; in the German edition of Mohr's excellent work *Pharmaceutische Technik* an entire chapter is devoted to the subject of arranging and fitting up a laboratory, while Dr. Adolf Duflos, of Breslau University, has also written and published a small, but very excellent, work on this subject.

Communications have been received from A. Freire Marreco; R. Mallet, F.R.S.; R. Carter Moffat; C. Griffin and Co.; S. Mellor; C. Greville Williams, F.R.S.; Dr. Adriani; W. Palmer; H. Russell; J. E. Morgan; Dr. Letheby; E. Blackwell; W. Sydney Gibbons, Melbourne; R. C. Clapham; Clarke and Company, Melbourne; Professor Horsford; R. R. Tatlock; W. Cass; Archibald Walker and Co. (with enclosure); Mawson and Swan; J. S. Brazier; F. Baden Benger; H. Hudson (with enclosure); A. Deiss (with enclosure); J. Hopkinson (with enclosure); Rev. R. C. Jones (with enclosure); Sturge and Co.; E. A. Sturman; The Kew Observatory; A. Geyger; W. Browning (with enclosure); Rumcorn Soap and Alkali Co.; J. Turner (with enclosure); and W. Little (with enclosure).

BOOKS RECEIVED.

Town Life among the Poorest: the Air they Breathe and the Houses they Inhabit. By John Edward Morgan, M.A., M.D., Oxon. London: Longmans, Green, and Co.

Report on the Sanitary Condition of the City of London for the year 1867-68. By H. Letheby, M.B., M.A., PhD., &c.

The American Journal of Science, January 1869.

THE CHEMICAL NEWS.

VOL. XIX. No. 480.

ON THE

CONSTITUTION OF COUMARIN, COUMARIC ACID, AND MELILOTIC ACID.*

By Prof. RUDOLPH FITTIG.

AT the conclusion of his very interesting treatise on the artificial production of coumarin (*Journ. of Chem. Soc.*, vol. vi., p. 53), Perkin develops his views on the formation and constitution of coumarin and coumaric acid. He assumes that in this reaction the hydride of aceto-salicyl, at a later date prepared by him (*Journ. of Chem. Soc.*, vol. vi., p. 181), at first results, and that this then gives off water :—

$$C_6H_4\begin{cases}COH\\Na\end{cases}O + C_2H_3O\}O \qquad \underset{\text{Hydride of aceto-salicyl.}}{C_6H_4\begin{cases}COH\\C_2H_3O\end{cases}O} + C_2H_3O\}O$$

and

$$\underset{\text{Hydride of aceto-salicyl.}}{\left.\begin{matrix}C_6H_4\\CH_3\end{matrix}\right\}}CO\}O - H_2O = \underset{\text{Coumarin.}}{\left.\begin{matrix}C_6H_3\\CH_3\end{matrix}\right\}}CO$$

Coumarin would thus have the constitution—

$$C_6H_3\begin{cases}CO\\C_2H_3O\end{cases}$$

and coumaric acid—

$$C_6H_4\begin{cases}COHO\\C_2H_3O\end{cases}$$

These formulæ, however, do not at all correspond with the behaviour of the two compounds, and at first sight even it appears improbable that an atom of hydrogen from the benzol residue should be used to the formation of water in the artificial production of coumarin. According to my view it is exceedingly probable that the reaction discovered by Perkin takes place in the same way as that discovered by Bertagnini in the artificial preparation of cinnamic acid from oil of bitter almonds and chloride of acetyl—

$$C_6H_5\{CHO + CH_3COCl = C_6H_5\{CH - COHO + HCl.$$

As hydride of salicyl is identical with hydride of oxybenzoyl—

$$= C_6H_4\begin{cases}HO\\CHO\end{cases}$$

it must give in the same reaction oxycinnamic acid, *i.e.* coumaric acid—

$$\underset{\text{Hydride of salicyl.}}{C_6H_4\begin{cases}HO\\CHO\end{cases}} + CH_3COCl = \underset{\text{Coumaric acid.}}{C_6H_4\begin{cases}HO\\CH\end{cases}} = CH - COHO + ClH.$$

or—

$$\underset{\text{Hydride of sodium-salicyl.}}{C_6H_4\begin{cases}NaO\\CHO\end{cases}} + (CH_3CO)_2O = C_6H_4\begin{cases}NaO\\CH\end{cases} = CH - COHO + CH_3COHO.$$

$$i.e. = \underset{\text{Coumaric acid.}}{C_6H_4\begin{cases}HO\\CH = CH - COHO\end{cases}} + \underset{\text{Acetate of sodium.}}{CH_3CONaO}$$

At the high temperature, and by the excess of the anhydride, the resulting coumaric acid is decomposed in the same manner as lactic acid by its transition into lactide, in the anhydride, *i.e.*, coumarin and water—

$$\underset{\text{Lactic acid.}}{C_2H_4\begin{cases}HO\\COHO\end{cases}} = \underset{\text{Lactide.}}{C_2H_4\{CO.O} + H_2O$$

$$\underset{\text{Coumaric acid.}}{C_6H_4\begin{cases}HO\\CH = CH - COHO\end{cases}} = \underset{\text{Coumarin.}}{C_6H_4\{CH = CH - CO.O} + H_2O.$$

According to this, coumarin is the anhydride of coumaric acid, and its easy transition into this acid, in being treated with potassa, can be easily understood. The decomposition of coumaric acid into salicylic and acetic acid, speaks highly in favour of the view that its constitution is similar to that of cinnamic acid, and that it stands to this in the same relation as salicylic acid to benzoic acid.

By treatment with hydrogen *in statu nascendi*, coumaric acid is converted into melilotic acid, the same as cinnamic acid is converted into hydrocinnamic (phenylpropionic) acid—

$$\underset{\text{Cinnamic acid.}}{C_6H_5\{CH = CH - COHO} + 2H =$$

$$= \underset{\text{Hydrocinnamic acid.}}{C_6H_5\{CH_2 - CH_2 - COHO}.$$

$$\underset{\text{Coumaric acid.}}{C_6H_4\begin{cases}HO\\CH = CH - COHO\end{cases}} + 2H =$$

$$= \underset{\text{Melilotic acid.}}{C_6H_4\begin{cases}HO\\CH_2 - CH_2 - COHO\end{cases}}.$$

Melilotic acid is, according to this, oxyphenylpropionic acid. It differs from phenyllactic acid (Glaser) only in this that the HO replaces an atom of hydrogen in the benzol residue, while in the phenyllactic acid it stands in the place of an atom of hydrogen in the group CH_2 of the propionic residue.

Heated, melilotic acid yields the anhydride—

$$C_6H_4\{CH_2 - CH_2 - CO.O,$$

(Zwenger), *i.e.*, hydrocoumarin, which must also result by adding hydrogen to coumarin, if the conversion of the anhydride into the acid can be prevented.

The views on the formation of coumarin, expressed above, explain also thoroughly the observation by Perkin, that by treating the hydride of aceto-salicyl with acetic anhydride there results no coumarin, a fact perfectly incomprehensible, if we assume with Perkin, that the artificial production of coumarin is a result merely of the abstraction of water from the hydride of aceto-salicyl. Perkin has further observed the interesting fact, that coumarin results when hydride of aceto-salicyl is heated with acetic anhydride with an addition of acetate of sodium. According to Perkin's view, the influence of the acetate of sodium is perfectly incomprehensible, inasmuch as it is impossible that acetate of sodium or a compound of this salt with acetic anhydride could have a stronger dehydrating influence than the anhydride, a fact which Perkin himself remarks.

According to my view, the action of the acetate of sodium consists in this—that at an elevated temperature it at first gives rise to a reversed reaction, *i.e.*, that it forms acetic anhydride and hydride of sodium-salicyl again—

$$C_6H_4\begin{cases}(C_2H_3O)O\\CHO\end{cases} + C_2H_3ONaO =$$

$$= C_6H_4\begin{cases}NaO\\CHO\end{cases} + (C_2H_3O)_2O.$$

The acetic anhydride acts only on this regenerated hydride of sodium-salicyl in the above-mentioned manner and forms coumaric acid, which, in its turn, breaks up into coumarin and water. This reaction explains, at the same time, why hydride of aceto-salicyl can be prepared only at a low temperature.

Another reaction observed by Perkin may be explained in the same way; Perkin could not obtain hydride of aceto-salicyl by the action of chloride of acetyl on the hydride of sodium-salicyl. Instead of this the hydride of

* Communicated by the Author.

disalicyl resulted; but it is incomprehensible why hydride of aceto-salicyl should not result in this way, and, in fact, Cahours has prepared this compound by means of this method. The hydride of disalicyl of Perkin is only a product of decomposition of the hydride of aceto-salicyl at first formed—

$$C_6H_4\begin{cases}NaO\\CHO\end{cases}+C_2H_3OCl=C_6H_4\begin{cases}(C_2H_3O)O\\CHO\end{cases}+NaCl$$

and

$$2\left[C_6H_4\begin{cases}(C_2H_3O)O\\CHO\end{cases}\right]=\begin{matrix}C_6H_4\begin{cases}CHO\\O\\CHO\end{cases}\\C_6H_4\end{matrix}+(C_2H_3O)_2O$$

and this reaction exhibits very clearly the tendency of the hydride of aceto-salicyl to give off acetyl at an elevated temperature. It makes the action of acetate of sodium, as assumed above, very probable.

Göttingen, Jan. 1869.

ON HYDROFLUORIC ACID.*

By G. GORE, F.R.S.

A. *Anhydrous Hydrofluoric Acid.*

THIS paper contains a full description of the leading physical and chemical properties of anhydrous hydrofluoric acid, and also an account of various properties of pure aqueous hydrofluoric acid. The author obtained the anhydrous acid by heating dry double fluoride of hydrogen and potassium to redness in a suitable platinum apparatus (shown by a figure accompanying the paper), and states the conditions under which it may be obtained in a state of purity.

The composition and purity of the anhydrous acid are shown and carefully verified by various methods of analysis, both of the double fluoride from which it was prepared and of the acid itself; and particulars are given of all the circumstances necessary to ensure reliable and accurate results. Nearly all the operations of preparing, purifying, analysing, and examining the properties of the acid were conducted in vessels of platinum, with lutings of paraffin, sulphur, and lampblack; articles of transparent and colourless fluor-spar were also employed in certain cases. Nearly all the manipulations with the acid were effected while the vessels containing it were immersed in a strong freezing-mixture of ice and crystallised chloride of calcium.

The pure anhydrous acid is a highly dangerous substance, and requires the most extreme degree of care in its manipulation. It is a perfectly colourless and transparent liquid at 60° Fahr., very thin and mobile, extremely volatile, and densely fuming in the air at ordinary temperatures, and absorbs water very greedily from the atmosphere. It was perfectly retained in platinum bottles, the bottle having a flanged mouth with a platinum plate secured with clamp-screws, and a washer of paraffin.

A number of attempts were made, finally with success, to determine the molecular volume of the pure anhydrous acid in the gaseous state, the acid in these cases being prepared by heating pure anhydrous fluoride of silver with hydrogen in a suitable platinum apparatus over mercury. Particulars are given of the apparatus employed and of the manipulation. The results obtained show that one volume of hydrogen, in uniting with fluorine, produces not simply one volume of gaseous product as it does when uniting with oxygen, but two volumes, as in the case of its union with chlorine. The gaseous acid transferred to glass vessels over mercury did not corrode the glass, or render it dim in the slightest degree during several weeks, provided moisture was entirely absent.

The author concludes that the anhydrous acid he has obtained is destitute of oxygen, not only from the various analyses and experiments already referred to, but also, 1st, because the double fluoride from which it was prepared, when fused and electrolysed with platinum electrodes, evolved abundance of inflammable gas at the cathode, but no gas at the anode, although oxides are by electrolysis decomposed before fluorides; and, because the electrolysis of the acid with platinum electrodes yielded no odour of ozone, whereas the aqueous acid of various degrees of strength evolved that odour strongly; and, 3rd, because the properties of the acid obtained from the hydrogen and fluoride of silver agree with those of the acid obtained from the double salt. He considers, also, that the acid obtained from pure fluor-spar and monohydrated sulphuric acid heated together in a platinum retort is free from oxygen and water.

The specific gravity of the anhydrous liquid acid was several times determined, both in a specific-gravity bottle of platinum, and also by means of a platinum float submerged and weighed in the acid. Concordant and reliable results were obtained; the specific gravity found was 0·9879 at 55° Fahr., that of distilled water being = 1·000 at the same temperature.

The anhydrous acid was much more volatile than sulphuric ether. Its boiling-point was carefully determined, in a special apparatus of platinum, and was found to be 67° Fahr. Not the slightest sign of freezing occurred on cooling the acid to −30° Fahr. (= −34·5 C.); and it is highly probable that its solidifying temperature is a very great many degrees below this. Its vapour-tension at 60° Fahr. was also approximately determined, and was found to be = 7·58 lbs. per square inch. On loosening the lid of a bottle of the acid at 60° Fahr., the acid vapour is expelled in a jet like steam from a boiler; this, together with the low boiling-point, the extremely dangerous and corrosive nature of the acid, and its great affinity for water, illustrates the very great difficulty of manipulating with it and retaining it in a pure state. Nevertheless, by the contrivances described, and by placing the bottles in a cool cellar (never above a temperature of 60° Fahr.), the author has succeeded in keeping the liquid acid perfectly, without loss, and unaltered, through the whole of the recent hot summer.

The electrical relations of different metals, &c, in the acid were found to be as follows at 0° Fahr. :—Zinc, tin, lead, cadmium, indium, magnesium, cobalt, aluminium, iron, nickel, bismuth, thallium, copper, iridium, silver, gas-carbon, gold, platinum, palladium,

Numerous experiments were made of electrolysing the anhydrous acid with anodes of gas-carbon, carbon of lignum-vitæ, and of many other kinds of wood, of palladium, platinum, and gold. The gas-carbon disintegrated rapidly: all the kinds of charcoal flew to pieces quickly, and the anodes of palladium, platinum, and gold were corroded without evolution of gas. The acid with a platinum anode conducted electricity much more readily than pure water; but with one of gold it scarcely conducted at all. These electrolytic experiments presented extreme difficulties, and were conducted in a platinum apparatus (shown by a figure) specially devised for the purpose. The particulars of the conditions and results obtained are described in the paper. Various mixtures of the anhydrous acid with monohydrated nitric acid, with sulphuric anhydride, and with monohydrated sulphuric acid, were also electrolysed by means of platinum anodes, the particulars and results of which are also described.

To obtain an idea of the *general* chemical behaviour of the pure anhydrous acid, numerous substances (generally anhydrous) were immersed in separate portions of the acid in platinum cups, kept at a low temperature (0° to −20° Fahr.). The acid had scarcely any effect upon any of the metalloids or noble metals, and even the base metals in a state of fine powder did not cause any evolution of hydrogen. Sodium and potassium behaved much the same as with water. Nearly all the salts of the alkali- and alkaline earth-metals produced strong chemical action. Various anhydrides (specified) dissolved freely. Strong aqueous

* Abstract of a paper read before the Royal Society, January 28th, 1869.

hydrochloric acid produced active effervescence. The alkalies and alkaline earths united strongly with the acid. Peroxides gave no effect. Numerous oxides (specified) produced strong chemical action, some of them dissolving. Some nitrates were not chemically affected, others (those of lead, barium, and potassium) were decomposed. Fluorides generally were unchanged, but those of the alkali-metals and of thallium produced different degrees of chemical action, those of ammonium, rubidium, and potassium uniting powerfully. Numerous chlorides were also unaffected, whilst those of phosphorus (the *solid* one only), antimony (the perchloride), titanium, and of the alkaline earth- and alkali-metals, were decomposed with strong action, and generally with effervescence. The chlorates of potassium and sodium were also decomposed with evolution of chloric acid: the bromides of the alkaline earth- and alkali-metals behaved like their chlorides. Bromate of potassium rapidly set free bromine. Numerous iodides were unaffected, but those of the alkaline earth- and alkali-metals were strongly decomposed, and iodine (in some cases only) set free. The anhydrous acid decomposed all carbonates with effervescence, and those of the alkaline earth- and alkali-metals with violent action. Borates of the alkalies also produced very strong action. Silico-fluorides of the alkali-metals dissolved with effervescence. All sulphides, except those of the alkaline earth- and alkali-metals, exhibited no change; the latter evolved sulphuretted hydrogen violently. Bisulphite of sodium dissolved with effervescence. Sulphates were variously affected. The acid chromates of the alkali-metals dissolved with violent action to blood-red liquids, with evolution of vapour of fluoride of chromium. Cyanide of potassium was violently decomposed, and hydrocyanic acid set free. Numerous organic bodies (specified) were also immersed in the acid; most of the solid ones were quickly disintegrated. The acid mixed with pyroxylic spirit, ether, and alcohol, but not with benzol; with spirit of turpentine it exploded, and produced a blood-red liquid. Gutta percha, india-rubber, and nearly all the gums and resins were rapidly disintegrated and generally dissolved to red liquids. Spermaceti, stearic acid, and myrtle wax were but little affected, and paraffin not at all. Sponge was but little changed. Gun-cotton, silk, paper, cotton wool, calico, gelatine, and parchment were instantly converted into glutinous substances, and generally dissolved. The solution of gun-cotton yielded an inflammable film on evaporation to dryness. Pinewood instantly blackened.

From the various physical and chemical properties of the anhydrous acid, the author concludes that it lies between hydrochloric acid and water, but is much more closely allied to the former than to the latter. It is more readily liquefied than hydrochloric acid, but less readily than steam; like hydrochloric acid it decomposes all carbonates; like water it unites powerfully with sulphuric and phosphoric anhydrides with great evolution of heat. The fluorides of the alkali-metals unite violently with hydrofluoric acid, as the oxides of those metals unite with water; the hydrated fluorides of the alkali-metals also, like the hydrated fixed alkalies, have a strongly alkaline reaction, and are capable of expelling ammonia from its salts. It may be further remarked that the atomic number of fluorine lies between that of oxygen and chlorine; and the atomic number of oxygen, added to that of fluorine, nearly equals that of chlorine.

B. *Aqueous Hydrofluoric Acid.*

Under the head of the aqueous acid the author enumerates the various impurities usually contained in the commercial acid, and describes the modes he employed to detect and estimate them, and to estimate the amount of H F in it. The process employed by him for obtaining the aqueous acid in a very high degree of purity from the commercial liquid is also fully described. It consists essentially in passing an excess of sulphuretted hydrogen through the acid, then neutralising the sulphuric and hydrofluosilicic acids present by carbonate of potassium, decanting the liquid after subsidence of the precipitate, removing the excess of sulphuretted hydrogen by carbonate of silver, distilling the filtered liquid in a leaden retort with a condensing tube of platinum, and, finally, rectifying.

The effect of cold upon the aqueous acid was briefly examined, the result being that a comparatively small amount of hydrofluoric acid lowers the freezing-point of water very considerably.

The chemico-electric series of metals, &c., in acid of 10 per cent and in that of 30 per cent were determined. In the latter case it was as follows:—Zinc, magnesium, aluminium, thallium, indium, cadmium, tin, lead, silicon, iron, nickel, cobalt, antimony, bismuth, mercury, silver, copper, arsenic, osmium, ruthenium, gas-carbon, platinum, rhodium, palladium, tellurium, osmi-iridium, gold, iridium. Magnesium was remarkably unacted upon in the aqueous acid. The chemico-electric relation of the aqueous acid to other acids with platinum was also determined.

Various experiments of electrolysis of the aqueous acid of various degrees of strength were made with anodes of platinum. Ozone was evolved; and with the stronger acid only, the anode was corroded at the same time. Mixtures of the aqueous acid with nitric, hydrochloric, sulphuric, selenious, and phosphoric acids were also electrolysed with a platinum anode, and the results are described.

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Continued from p. 32.)

Unwholesome and Adulterated Food.

As regards the injurious quality of meat infected with parasitic disease there can be no question; and, perhaps, of all such infections, the most terrible is the *trichina* of pork. Fortunately, it is a rare affection in this country, although it is often common in Germany. The pork infected with the worm is generally darker than usual, on account of the irritating or inflammatory action of the creature lodged in the muscles; and when the parasite is encysted the meat presents a speckled appearance—the minute white cysts containing the worm being just visible to the naked eye. Here are specimens of it in both its encysted and non-encysted conditions; and this diagram represents the appearance of the worm when it is examined under the microscope. It is, as you see, a minute thread-like worm, about the thirtieth of an inch in length, coiled up in a spiral form; hence its name, *trichina spiralis*. It is generally found in the human subject in an encysted state, when it has passed beyond its dangerous condition and has become harmless. In most cases, when thus discovered, there is no record of its action, and therefore it was once thought to be an innocent visitor; but we now know that while it was free—that is, before nature had barricaded it up in the little cyst, its presence was the cause of frightful disorder—killing about 50 per cent of its victims in terrible agony. In Germany, there have been frequent outbreaks of the disease, which, for a time, baffled the skill of the most experienced physicians; in fact, we hardly know how long or how often the disease has attacked the pork-feeding population of Europe, for its actual nature was unknown until the year 1860, when Dr. Zencker, of Dresden, discovered the pathology of the disease. Since then there have been several visitations of it, as at Plauen, in Saxony, in 1862; at Hettstadt, near Eisleben, in 1863; and at Hedersleben, near Magdeburg, in Prussian Saxony, in 1866. In all these

* The Cantor Lectures, delivered before the Society of Arts.

cases the same symptoms, or nearly the same were observed; there was sometimes immediate disturbance of the digestive functions, but more commonly a day or two elapsed before any particular symptom was noticed, and then there was a feeling of lassitude, with a loss of appetite, and pains in the head and back. Then followed a serious disturbance of the alimentary canal, with vomiting and diarrhœa. This lasted for a day or two; and by the end of a week after the worm had been eaten fever had set in, which became more and more severe, and by that time the young worms which had been hatched in the body had migrated to the distant muscles, causing the most excruciating pains, so that the patient, fearing to move his inflamed muscles, would lie motionless upon his back; and if he did not die in this state of the disorder nature came to the rescue, and imprisoned the creature by surrounding it with a fibrinous cyst, where it lives for years, being ready at any moment to acquire activity when it is swallowed and released from its cell. Indeed, the way in which it becomes dangerous is this—flesh infected with the parasite is eaten; and the cyst being quickly dissolved by the gastric juice, the creature is set free. Finding itself in the midst of nourishing food it rapidly grows, so that in two or three days it is three or four times its original size, and may be easily seen, like a bit of fine thread, with the naked eye. The worms are of different sexes, and they rapidly come to maturity—each female giving birth to from 300 to 500 minute thread-like worms, which immediately set out upon their travels, piercing the walls of the intestines and migrating to distant parts of the body, where they produce the terrible mischief I have described. Although the pig is the animal which is most commonly infested by it, yet it has been found in the muscles of dogs, foxes, badgers, sheep, moles, hedgehogs, rats, mice, frogs, and most carnivorous birds, all of which must have been subjects of the disease, but none appear to suffer from it like man; even children are less affected by it, for they seem to sleep it away. Fortunately, there is an easy method of discovering its presence in animals, for the most certain seat of the creature is in the muscles of the eye; we have therefore only to examine these muscles with the microscope to declare whether the meat is infected or not; and, at the present time, the sausage makers of Germany have the pork examined in this manner before it is used for food.

Other parasitic creatures, as measles in pork, and the smaller *cysticerci* of beef and veal, are found as little sacs or bladders diffused through the lean of the meat—the *cysticercus* or measle of pork being easily seen, for it is as large as a hemp-seed. Here are specimens of it in a fresh condition, which were seized in the City markets to-day; but the *cysticercus* of other animals is much smaller, and requires careful exploration to discover it. In both cases the sac contains a little creature with a sort of tuberculated head, crowned with a coronet of hooks, and having a bladder-like tail attached to it. Soon after it is swallowed, the enclosing sac is dissolved by the gastric juice, and the creature being liberated passes into the intestines, and there fixes itself by its little hooks, and quickly grows, joint after joint, into a tape-worm. In the case of the *cysticercus* of pork, it forms the variety of tape-worm called *tenia solium*, and in that of beef and veal it produces the *tenia mediocanellata*. The latter is the most common variety of it in the human intestines, and it is frequently seen where raw, or nearly raw, meat is made use of, as in Abyssinia and in Russia, where children are allowed to suck a piece of raw beef, on the supposition that it has a strengthening property. Each segment of the worm is an independent creature, containing myriads of ova, and when passed by the bowels, it gets with the manure upon the land and is eaten by pigs, oxen, and goats; the ova are then hatched in the stomach, and they pass, as in the case of the *trichinia* through the walls of the intestine, and migrate to the muscular tissues of the body, whers they become encysted, and form the little sacs or measles, which remain dormant for years, though they are ever ready to become tape-worms directly they are eaten. In this manner the creature is perpetuated, first as a tape-worm with joints in the intestines of one animal, and then as a measle or larva in the muscle of another, and then again as a tape-worm. By a like process the *tenia chinococcus*, or little tape-worm of the dog, becomes the hydatid in man and other animals. In Iceland the dogs are very liable to this infection, and the cattle and sheep, as well as man, suffer from the hydatid of it. The subject has been well investigated by Dr. Leared, who has shown that the practice of giving the diseased offal of the slaughtered animals to dogs causes tape-worm, and the dogs drop the segments of the worm fiilled with ova, upon the pastures and into running water. By this means they enter the bodies of cattle and sheep, and even of man, and then, as in the last case, the ova quickly become developed, and the young hydatid or larva tape-worm, piercing the walls of the alimentary canal, migrates to distant parts, and finding a suitable nidus for its growth, it slowly becomes a large bladder-like hydatid. In the case of the sheep it often selects the brain for its habitat, and produces the disease called staggers; in the oxen it grows in the peritoneal cavity; and in man it haunts the liver, occasioning frightful disturbance of the system, and causing one-sixth of the total mortality of that country. Here are specimens of the disease from the human subject.

Again, there is another class of parasite, called *trematoda* or flukes, which infest the livers and intestines of men and herbivorous animals. The most common of them is the *distoma hepaticum* or liver-fluke of the sheep. In wet seasons the animal is so constantly infested with them, and suffers so much emaciation from them, that the disease is called the rot. You have before you infected livers which were seized in our public markets this very day, and there is no difficulty in obtaining specimens of them at almost any time. A few years ago (1863), when Professor Brown was lecturing on the liability of animals to disease from the present mode of feeding them, he said that once, when he wanted some animals for dissection, and applied for them to a large butcher, he received back five or six animals, which, though in a bad state of rot, were dressed for the market; and he was told by a certain individual not far from London, that within the space of six months he had killed no less than 750 of such animals, in a state of extreme disease, and he believed they were all sent to market and sold for food. What becomes, he says, of the hundreds and thousands of rotten sheep which we see in the fields? To bury them would require whole catacombs; the real catacombs are the intestinal canals of the human body. The way in which the disease is produced in sheep is curious. Ova are passed from the gall-bladder of infected animals into the intestines, and so upon the land; finding a moist situation they are soon hatched into ciliated embryos, which swim about and become developed into cylindrical sacs of minute hydatids; these attach themselves to some mollusc, as a small snail. In wet weather the infected snails crawl upon the grass, and are eaten by the sheep, and then the hydatid speedily changes his condition and becomes a fluke. When it is found in the body of man it has, perhaps, been drunk with water or eaten with some aquatic plant, as water-cress, &c.

Our safety against these intruders is to cook the meat thoroughly.

The flesh of animals that have been excited before death, as by over-driving, or by torture, has frequently proved unwholesome. A remarkable instance of this is quoted by Liebig, in his "Letters on Chemistry," where a family of five persons were made seriously ill by the flesh of a roebuck which had been caught in a snare, and had struggled violently before death.

It is, moreover, a curious fact, that meat may be even poisonous from the nature of the food made use of by animals shortly before they are killed; and this, too, without any indication of disorder in the animals themselves. Hares which have fed upon the *Rhododendron chrysanthemum* are frequently poisonous; the same is the case

with pheasants in Pennsylvania and Philadelphia, which feed during the winter and spring on the buds of the laurel (*Calmia latifolia*); and I have known many instances of serious mischief from prairie birds which are now largely imported into this country from America, and I attribute it to the food made use of by the bird. In certain districts of North America, especially on the Alleghany mountains, the flesh of all the cattle is poisonous, and so also is the milk they yield, and the cheese which is made from it. Oysters, mussels, lobsters, and crabs have frequently caused disturbance of the human system; and the probability is that they were made unwholesome by the food which they had eaten. A singular case is recorded in the medical journals of France in 1842, where a whole family at Toulouse were poisoned by a dish of snails, the animals having been gathered from a poisonous shrub (*Coriaria myrtifolia*); and it is not at all uncommon for honey to be unwholesome, on account of its having been collected by bees from poisonous plants. The honey of Trebizond, for example, has long been notorious for its deleterious properties; it poisoned the soldiers of Xenophon during the famous retreat of the ten thousand. Pliny, too, speaks of it; and to this day its intoxicating effect is frequently witnessed. It arises, no doubt, from the plants, chiefly the *Azalea pontica*, from which the honey is gathered. Mr. Barton has given us a similar account of the poisonous quality of the honey gathered by bees from the savannahs of New Jersey, where the *calmia* and *azalea* are the principal flowering shrubs. As with the followers of Xenophon, all who eat of the honey become intoxicated to a high degree; and even when made into metheglin, it poisons all who partake of it, causing dimness of sight, giddiness, and then delirium, with sometimes a fatal termination.

(To be continued).

THE SALT DEPOSITS AT STASSFURT.*

By Messrs. BALD and MACTEAR.

(Concluded from page 66.)

IN the fourth and last division, which is called the *carnallite region*, the insoluble salts are entirely gone, and even the common salt gives place in quantity to the more soluble carnallite, the average composition being:—

Carnallite	55
Common salt	25
Kieserite	16
Hydrated chloride of magnesium..	4

Carnallite, when pure, consists of $KCl+MgCl_2+6H_2O$, having a specific gravity of 1·618, and dissolving in about one and a half times its weight of water at 18° C.; it is crystalline, clear, and colourless, but as found in the mine it varies from pure white to a deep red colour, owing to the presence of minute quantities of peroxide of iron. This peroxide of iron, when separated from the salts, presents the appearance of a coppery bronze powder, but when viewed under the microscope it is found to consist of distinct crystals of exceedingly beautiful appearance, varying in colour from golden yellow to dark red.

The carnallite is very deliquescent, and, on exposure to a damp atmosphere, the chloride of magnesium gradually drains away, leaving the chloride of potassium behind. This probably accounts for the presence of sylvin, or pure chloride of potassium, small quantities of which are found underneath the carnallite; it is rather more abundant in the Anhalt mine, and this would further tend to prove the theory that it is the product of the decomposition of carnallite, as the chloride of magnesium is found to preponderate in the lower lying level of the Stassfurt mine as *tachydrite*.

Sylvin is variously coloured, and has a bright shining appearance, which has been not inaptly compared to mother-of-pearl. Its specific gravity is 2·025, and 34·5 parts of it dissolve in 100 of water at 18¾° C.

It is occasionally found in large perfectly transparent crystals, which, according to Professor S. Magnus, of Berlin, are as transparent to heat as rock salt; and this diathermic property does not change with the temperature of the source of heat any more than rock salt does, and which has hitherto been the only substance known to possess the latter quality.

The tachydrite already mentioned is a salt having the same composition as carnallite, but in which the potassium is replaced by calcium, its formula being $CaCl_2+2MgCl_2+12H_2O$. It is very deliquescent and very soluble, 100 parts of water at 18¾° C. dissolving 160·3 parts of the salt; it is the only salt which raises the temperature of the water during solution, all the others having the property of lowering it during that operation.

Besides sylvin and tachydrite, there exists also, though in such irregular quantities that it cannot be calculated upon with certainty, a salt called kianite, having the following composition:—$MgSO_4+K_2SO_4+H_2O$. It is evidently the product of a secondary decomposition, arising from the action, probably, during a low temperature, of sulphate of magnesium upon chloride of potassium.

We also have what is probably the most peculiar and unaccountable compound in these mines—viz., boracite, the composition of which is $6MgO,8B_2O_3+MgCl_2$ (sp. gr. 2·3); it is found scattered all over the deposit in nodules varying in size from the most minute up to 7 or 8 inches in diameter, and, although occurring in the most soluble salt beds, is of itself almost insoluble in water, and, in fact, is with difficulty decomposed by acids; but its greatest peculiarity is, that it always, and without exception, contains a kernel of the easily soluble carnallite or tachydrite; it does not exist in any great quantity, the annual yield being somewhere about 10 tons. A small quantity of bromine is also found in this region, existing as bromide of magnesium; cæsium and rubidium can also be detected; but hitherto all attempts to prove the presence of either lithium or iodine have been without success.

The ingredients in this region do not exist as a homogeneous mass, but are deposited in distinct layers, which repeat themselves frequently, and vary in thickness from a mere line to several feet.

It is from the impure carnallite that the manufacture of muriate of potash is so largely carried on in the neighbourhood. This salt, which is coarsely ground at the mines, has an average composition of—

Chloride of potassium	16
Chloride of magnesium	20
Chloride of sodium	25
Sulphate of magnesia	10
Water	29
	100

It also contains small quantities of sulphate of lime and bituminous matter, which occasion the manufacturer some considerable trouble, as in strong solutions they are light and flocculent, and, consequently, somewhat difficult to settle.

The manufacture of the muriate is entirely a question of the solubilities of the various salts, the key to which is the fact that the double salt of chloride of potassium and magnesium forms only from solutions containing exactly double the quantity of chloride of magnesium which exists in the carnallite. You will find it stated by various authorities that the "carnallite crystallises only from solutions containing a large excess of chloride of manesium," but this has been proven by experiment to be a definite chemical quantity, viz., 4 parts of chloride of magnesium, and 1 part of chloride of potassium, or, in other words, 2 parts of chloride of magnesium, hold in solution up to a certain strength 1 part of carnallite.

* Read before the Chemical Section of the Glasgow Philosophical Society, January 18, 1868.

So that on dissolving the crude salt in water, the chloride of magnesium takes up its quantity of chloride of potassium, whilst the remainder crystallises out as muriate, mixed with common salt and a small quantity of sulphate of magnesia. The mother liquors are then further boiled down to obtain a crop of artificial carnallite, which in turn is treated in a similar manner to the raw salt, to obtain a further supply of muriate. The muriates produced vary in strength from 75 to 98 per cent.

Epsom salts are also prepared at some of the works from kieserite, whilst at others a considerable quantity of the double sulphate of magnesium and potassium, a compound containing one equivalent of each of the sulphates, combined with 6 atoms of water, is made.

This salt is largely used as a manure for the sugar beet. It is generally understood that the beet grows equally well with soda as with potash, but the cultivators prefer to use the latter, as it is nearly all recovered in the state of carbonate, and of course is greatly enhanced in value. This leads us to consider what would have been the present state of the potash trade had it not been for the opportune discovery of this deposit, previous to which our only sources of potash were the muriate and sulphate from kelp, principally wrought in Glasgow, and the north of Ireland, and the carbonate or potashes of North America. Whether the supply has regulated the demand or not it is difficult to say; but it is a fact that the produce from the two last-named sources has rather increased than decreased, whilst we have in addition the large supply obtained from the Stassfurt deposits.

This, of course, has been followed by a corresponding reduction in price—muriates of 80 per cent, which in 1863 sold at £21 10s. per ton, can now be purchased for £8 10s.

The carbonate has not fallen in the same ratio owing to the increasing employment of it in the arts and manufactures.

There is, consequently, a great prize in store for the chemist who, by his ingenuity, can discover some more direct process than that at present in use for the conversion into carbonate of the vast quantities of chloride stored up in these German mines.

To the scientific chemist and geologist this deposit presents a vast field well worthy of attentive study and research.

The generally accepted theory is that it is the product of the slow evaporation of some vast ocean, by a process similar to that which is at present going on in the Dead Sea, the waters of which are supposed to have already been evaporated down to 1300 feet from their original level. If we examine an analysis of this sea, we find that it contains 6¼ per cent of chloride of sodium, 1¼ of chloride of potassium, 2¾ of chloride of calcium, 10¼ of chloride of magnesium, and about ¼ of bromide of magnesium. The sulphates have almost entirely disappeared, and, looking at the preponderance of the more soluble salts over the chloride of sodium, we are forced to the conclusion that there must be already deposited at its bottom a vast quantity of the latter salt.

The great salt lake of North America, and some others, in the south of Russia, and in Asia, which contain almost nothing but chloride of sodium, must be regarded as fresh water lakes, which derive their saline matter from some already formed deposits of salts.

In August, 1867, the Prussian government commenced boring for salt at Sperenberg, and at the end of August, last year (1868), they had penetrated to a depth of 952 feet, principally through gypsum, when they suspended operations, to admit of more powerful instruments and machinery being made. These being now supplied, the work is again going on. There is no doubt that they will reach the salt strata, and we await the result with considerable interest, to see if the potash salts exist there also.

There are others besides scientific men, to whom these mines are a source of considerable interest. To the political economist they mean an almost inexhaustible supply of the "savour of the earth," employment to the people, trade to the country, and pounds, shillings, and pence to the merchant and manufacturer.

To the visitor, be he scientific or non-scientific, a visit to the mines will amply repay him for his trouble.

The appearance of the workings in the kali salt portion of the mine is no less beautiful than wonderful, and is so entirely unlike what we see in mines in this country that we are entirely at a loss for anything to which we can compare them, and it is utterly impossible for any description to prepare the visitor for the novel sight which meets his eye when he enters these workings for the first time.

All have heard of, and many have witnessed, the wonderful grandeur of the Mammoth and other caves of North America, with their unfathomable subterranean rivers, where size and form, together with the light and shade produced by the flickering torches of the guides, are what excites the admiration of the traveller.

At Stassfurt we have neither the rivers nor the vast size, but we have space, which, in the bowels of the earth, seems great; we have beautiful form in the sparkling irregular angles formed by the pick and in the cavities left by the blast, to enhance which there is the magic charm of colour—colours of nearly every tint in the rainbow, passing from a deep purple through crimson, bright red, orange, and yellow, to snowy white, all in regular layers, but varying in size and arrangement, and from the angle of the dip each layer forming an almost perfect arch. The effect is further heightened by the nodules of boracite, which have the appearance (as graphically described by a Glasgow gentleman who is well acquainted with the mine) of having been shot at random from a park of artillery, so irregularly are they scattered, and so firmly are they imbedded in what meanwhile seems to us an altogether foreign place for them.

On the occasion of our visit, after having been conducted through such a gallery as we have attempted to describe, we left the main working, and after going a few yards through a narrower passage we found ourselves in a small chamber about 20 feet square—the preliminary opening for a new working. Underneath what is now the roof of this cavern there had been a lodgment of water, which had completely dissolved all the more soluble salts, and left the common salt and chloride of potassium in magnificent crystals of absolute purity; this formed a dome-shaped roof, which, sparkling and glistening in the light of our lamps, rivalled in beauty anything we had ever imagined of the celebrated Valley of Diamonds.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 4, 1869.

Dr. Warren de la Rue, F.R.S., President, in the chair.

After the usual formal business, the President announced that Dr. Wallace, of Glasgow, who had promised a lecture "*On the Chemistry of Sugar Refining*," had been prevented by illness from attending, but that he had forwarded his diagrams and tables, together with the MS. of his lecture, and that the latter would now be read by the secretary.

Mr. Vernon Harcourt accordingly proceeded to read the discourse, of which the following is an abstract:—

After a few introductory remarks upon the complexity of the science of chemistry, upon the importance of the technological branches of it to many Fellows of the Society, and upon the encouragement afforded to the study of those branches by the Society, the author draws attention to the statistics of the sugar trade in this

country. From the Board of Trade returns for 1868, it appears that 594,656 tons of sugar of all sorts were imported in that year. The duty on this quantity amounted to nearly five and a half millions, and the total money value, including duty, to £21,000,000. At least 400,000 tons were refined in this country. Foreign countries, particularly France, offer very formidable opposition to the English refiners, no less than 34,039 tons in 1868, and 42,047 tons in 1867, of refined sugar having been imported. The author has shown, in a previous discourse*, the unfair terms on which our refiners have to deal with foreign countries. He attributes the present stagnation of the sugar refining trade in London mainly to this unfair competition, but also to the extraordinary development of the industry within the last few years in Greenock and Glasgow. In 1857 the quantity of sugar refined in the Clyde was 38,336 tons, while in 1867 the quantity had risen to 178,013 tons. Last year it amounted to only 171,643 tons, but even this quantity is two-fifths of the whole amount of sugar refined in the United Kingdom. The author believes that the London refiners have been somewhat slow in adopting the most recent improvements introduced in the provincial refineries, and they have been unwilling to give up the making of loaf sugar, which is not now profitable. They work, moreover, under considerable disadvantages in various respects. The refining process here described is that adopted at Greenock for crushed or soft sugar. Its chief peculiarity is that no syrup is produced; all the sugar leaves the refinery in the solid form, and the loss of all kinds only amounts to about 5 per cent.

Sugar Refining.—A proper selection of the raw sugar is a very important point in the refining process. In the Greenock system the raw sugar employed must not contain more than 3 or 4 per cent of uncrystallisable sugar; but where syrup is produced this is of less importance, and concrete and low sugars may be used. Mixtures are often judicious, but on the Greenock system a large proportion of beet sugar is avoided. Several points must be considered in purchasing raw sugar for refining—the proportions of cane and fruit sugar, the amount of extractive, as determining the quantity of animal charcoal required and its deterioration in the process, and the amount of insoluble matter, which, when excessive, is troublesome to wash, must all be taken into account.

The author next gives a table of the composition of twenty samples of raw sugar of different kinds, but remarks that they must not be taken as typical of the various kinds indicated, as they vary extremely in composition.

The French mode of determining the value of a sample of sugar is, upon the whole, a very fair and accurate one. Each percentage of fruit sugar is assumed to prevent the crystallisation of 1 per cent, and each percentage of soluble salts of 5 per cent of cane sugar; thus a sample of Paraiba sugar contained 84·9 of cane sugar, 6 of fruit sugar, and 1·7 of soluble salts; this sample would accordingly yield 70·4 per cent of cane sugar.

First Operation—Solution.—This, which is technically known as "blowing up," from the fact that open steam was formerly used in it, is effected on the highest floor but one of the building. The blow-ups are cast-iron pans, 4 or 5 feet high and 6 to 10 feet in diameter. The steam is admitted by a heating worm below a false bottom; above and below this false bottom revolving arms keep the liquor in constant motion. Water is introduced into the blow-up, the steam turned on, and the sugar thrown in as quickly as possible from the floor above. In half an hour the filling should be completed, when the liquor should have a specific gravity of about 1·225 (28° Baumé) and a temperature of 180° F. It consists of about two parts of raw sugar to one of water, and a pan of 10 feet diameter will dissolve about 7 or 8 tons of raw sugar. A small amount of flocculent and insoluble matter is removed as scum during the operation. This is the simple process pursued in most of the Clyde refineries; but in others various methods of treatment are adopted to facilitate the purification. Milk of lime is sometimes added to neutralise the small trace of acidity in the raw sugar, and the author thinks this useful, provided that an excess is avoided. The use of blood or albumen was formerly common, but as they render the syrups impure, they are now generally dispensed with. Other reagents have also been used, such as sulphate or phosphate of aluminium or lime, or soluble tricalcic phosphate and lime, but there is great danger of the workmen adding too much of one or another of them, and their use does not appear to be necessary. The dust of animal charcoal has a good effect when quite new, but it cannot be used more than once.

The next operation consists in passing the solution through twilled cotton filter bags in coarse canvas sheaths. These bags are fastened, to the number of 200 or so, to the bottom of a shallow tank, into which the liquor from the blow-up pan is passed. The sides are kept hot by steam.

Decolourising the Syrup.—Animal charcoal has been found by practical experiments to be the most suitable for sugar refining. Many kinds have been tried, some of them much more energetic than it as decolourising agents, but none possess its peculiar combination of valuable qualities. An artificial mixture of clay and some form of carbon has been said to rival animal charcoal, but the author has heard nothing of it lately. Seaweed charcoal approaches most nearly to that of bones, but wants some necessary characters. Sulphurous acid has been tried repeatedly, but it never removes more than three-fourths of the colouring matter, and its liability to change into sulphuric acid renders its use dangerous; for though sulphurous acid does not alter cane sugar, the latter acid does, and even if this is neutralised by lime, the resulting sulphate of lime is injurious to the charcoal, which must subsequently be used. The author has made no experiments on the bleaching action of ozone, but fears that its oxidising action on the sugar would prove troublesome. The carbonatation process used on the Continent is excellent for the juice of the beet, but would not be advantageous in the refining of raw cane sugar. It might be found useful in certain cases, as for instance in purifying the washings of animal charcoal. The author considers that it is an excellent arrangement to have a smaller refinery connected with the larger one for the separate treatment of impure products. The use of alcohol with a minute portion of hydrochloric or acetic acid, to remove earthy salts before filtration, is next discussed; it has been tried on the large scale in Belgium, but discontinued. Theoretically, it is most advantageous, but its expense would be fatal to its use here, except, perhaps, with duty-free spirit. A moderate-sized sugar house would require about 10,000 gallons of almost absolute alcohol, and this must be re-distilled every day. The process has long been used most successfully for testing raw sugars.

Filtration through Charcoal—The clear liquor is now run into iron tanks filled with animal charcoal, allowed to "settle" for several hours, and drawn off colourless below. At the same time more of the dark liquor is run in at the top, so as to keep the cistern full. When the sugar solution begins to come away yellow, the sugar solution is replaced by the syrup from a previous refine; the whole of the sugar is then washed out with hot water, and the charcoal, after draining, is taken to the kiln to be re-burned. The author gives many interesting details as to the size of the cisterns, the size, or "grist" of the charcoal, &c., which our limits compel us to omit. He refers, for a full discussion of the qualities of animal charcoal, to a lecture delivered in Glasgow during last year, and duly recorded in our pages*. In the present discourse

* Chemical News, Dec. 18, 1868.

*Chemical News, May 22nd, 1868.

he confines himself to the consideration of certain points.

Three analyses of new animal charcoal are first given, the samples containing respectively 9·71, 7·64, and 10·37 of nitrogenous charcoal, in the dry substance. As sold it generally contains about 10 per cent of water. The so-called carbon of animal charcoal contains a notable proportion of nitrogen, and a little hydrogen. The nitrogen is generally about 1-10th of the total carbonaceous matter, but is sometimes considerably more. Old charcoal contains less nitrogen, and the proportion constantly diminishes. The nitrogen appears to be an essential constituent of animal charcoal. Red-hot animal charcoal, quenched with water, evolves ammonia, and the practice ought, therefore, to be avoided. New charcoal always contains traces of ammonia, as well as of sulphides of ammonium and calcium. In a particular case, ·011 per cent of ammonia was found; and in another, a sample of charcoal evolved ·08 per cent of hydric sulphide when treated with an acid. Both new and old charcoal retains appreciable quantities of gases, which escape when the tanks are filled with liquor, and sometimes explode when a light is brought to the top of the cistern.

Old charcoal should always contain more carbon than new, on account of the carbonisation of the impurities separated from the sugar. If the carbon does not increase with the age of the charcoal, it shows either that air has been admitted during the re-burning or that the re-burning has been effected at too high a temperature. The increase of carbon in the charcoal is an evil, and should be diminished as far as possible by thorough washing before it is re-burnt. The extensive washing has another advantage, for it tends to remove the mineral salts, particularly calcic sulphate, which had been taken up from the sugar. As long as the sugar liquor is strong, calcic sulphate is absorbed and retained by animal charcoal; but when the washings begin, the salt comes away in solution.

Another cause of the deterioration of charcoal is the constant shrinking of its volume, and its consequent diminution in porosity. A ton of new charcoal usually occupies about 50 cubic feet, but this diminishes to 40, and even in one case to 28 cubic feet. This appears to be due to a partial fusion of the calcic phosphate, and is not accompanied by any great alteration of specific gravity. All these considerations point to the necessity of renewing the charcoal very frequently. With regard to the quantity of charcoal required, much depends on the nature of the sugar. For a ton of sugar, 25 cwts. of good charcoal is amply sufficient; and for fine sugar an equal weight is enough. The less used the better; and it is a mistake to suppose that a large quantity of bad or exhausted charcoal will serve the same purpose as a smaller amount of good. The work will not be so well done, and the waste of sugar will be greater. As illustrations of the composition of old charcoal, the author gives his analyses of nine samples, which differ very remarkably in composition. The percentage of nitrogenous carbon varies from 2·56 to 19·64.

The calcic carbonate in charcoal is useful in neutralising the minute quantity of acid present in all sugars and also the acids always formed during the washing of the charcoal. When very soft water is used, the quantity of calcic carbonate diminishes or even disappears. On the other hand, with very hard waters, or when lime is added in the process, as in the beet factories of the Continent, it often increases to an inconvenient extent. This is best remedied by Mr. Beanes's process, which consists in impregnating the burnt charcoal with perfectly dry hydrochloric gas, exposing it to the air until the excess escapes, washing thoroughly with water and burning. Beanes's process, and others of a similar nature, may be applied with advantage to new charcoal, to bring it at once into efficient working condition.

The oxidising power of the charcoal is attended with a grave inconvenience in sugar refining. When the char cisterns are to be washed off, hot water is introduced, while the heavier syrup descends, but the liquids commingle to some extent, and a weak solution of sugar is formed, which is exceedingly liable to undergo the lactic fermentation. The ferment appears to be generated by the action of the dissolved oxygen of the water under the influence of the charcoal upon the vegetable albumen removed by the charcoal from the sugar. It is a common, but very mistaken custom to use the char washings in dissolving fresh sugar.

With respect to the temperature required in the refining process, the liquor in the blow-up pans should be run off at 180° F.; the char cisterns should be at 155° F., and never below 150°; and the water used for washing should be absolutely boiling. The minimum quantity of water required for refining 100 tons of sugar is about 215 tons, or nearly 50,000 gallons.

Revivifying of the Charcoal.—The re-burning of the charcoal is effected in kilns, which consist of upright cast-iron pipes arranged in rows. The wet charcoal is introduced at the top, and sinks down as from time to time the portions which are sufficiently burned are drawn off at the bottom. The flame plays directly upon the pipes, and those which are nearest to it receive the most heat, and their contents must be exposed to it for a proportionately less time—five hours being sufficient for the nearest row, whereas ten hours may be required for the farthest. It is a great mistake not to dry the charcoal, either partially or completely, before introducing it into the kilns, as the wet mass hinders the escape of gases from the lower portions, and much heat is wasted in evaporation.

Evaporation of the Liquor.—This is effected, as is well known, in the vacuum pans. The improvements introduced of late years into the vacuum pans consist in increasing the extent of heating surface and the quantity of water injected into the condenser, and in enlarging the neck of the pan to 18 inches, or even more. A good-sized pan is 10 or 12 feet in diameter, and holds about 20 tons of sugar and syrup. The boiling down occupies two or three hours, the vacuum averages about 28 inches, and the temperature is usually about 120° F. at the beginning, and about 130° F. at the end of the process. The solution is introduced a little at a time, and the first portion is boiled until a "grain," consisting of almost microscopic crystals of sugar, forms, and these increase in size as the boiling proceeds, until at the finish they are as large as may be desired. When large, distinct crystals are required, the liquid is boiled more slowly and at a higher temperature, and when the pan is full, only one-half of the contents is drawn off. This is repeated several times, the crystals becoming larger every time. The author points out that it is not necessary to increase the temperature, but only to diminish the rapidity of the boiling, in order to obtain fine crystals. The high temperature usually employed for the production of large crystals only serves to increase the quantity of uncrystallisable sugar formed, and to darken the colour of the syrup.

In boiling down the syrup obtained from the drainage of the first crop of crystals, less care is required, a small grain being preferred as carrying more syrup. Three qualities of sugar are usually prepared by this process, viz., whites, mediums, and yellows. For the yellows, the syrup is evaporated as a "jelly," that is, the formation of grain is entirely avoided, and the jelly is left for several days to crystallise. The crystals of all three kinds are separated from the syrup by a centrifugal machine, the periphery of which travels something like 100 miles an hour. From three to twenty minutes are occupied in the drainage, according to the quality of the sugar. The whitest crystals are sometimes washed with a little cold water.

The PRESIDENT pointed out that other charcoals, not containing phosphate of lime, gradually contracted, and got hard when exposed to long-continued, although not necessarily very excessive, heat. It was well known that

coke burnt at a low temperature became extremely dense. He knew from his own experience that light porous charcoal or coke would, if the heat were continued for a very long time, gradually contract. Gold, precipitated in a porous state by a proto-salt of iron, gradually contracted when heated far below the melting point of the metal. Referring to some experiments of his own made many years ago, the President stated his impression that lime really converted sugar into an uncrystallisable state, and that the addition of an acid did not then restore it. It appeared that animal charcoal still held its ground as a decolourising agent, in spite of all the new plans proposed. Its remarkable absorbent power reminded him of that which he had observed in sulphide of lead during his investigations on carminic acid; it entirely removed all the colouring matter, and led to the misapprehension that the cochineal was being changed in its nature.

Dr. HUGO MULLER remarked that lead could not be used with advantage in the treatment of liquids like sugar. Dr. Scheibler had recently found that several liquids of that kind had a very extraordinary power of dissolving and retaining sulphide of lead, and that this lead could not afterwards be separated from them.

Mr. PEARSON deplored the unavoidable absence of Dr. Wallace, as there were many points upon which further information would have been desirable. He commented upon some points connected with the statistics of the trade, and made a few observations on the marvellous powers of animal charcoal. The remarks of Dr. Wallace on the washing out of the products were very important, but, in the south, a limit is rapidly attained in the washing, for even when the New River water was used, it was soon found to be running off purer than when it was put on, from the abstraction of the earthy matters by the charcoal.

Dr. HUGO MULLER stated, in reply to a question put by the President, that the decolourising power of animal charcoal was reduced, though not destroyed, when the phosphates were dissolved out of it by hydrochloric acid.

Mr. WILLIAMS confirmed this statement. The pure charcoal would do more than the common charcoal, bulk for bulk, but there was no comparison in the percentage action of the carbon in the two cases.

Dr. VOELCKER requested permission to ask Mr. Beanes, who was present, the result of his experiments on the decolourisation of sugar by ozone.

Mr. BEANES feared that the ozone process was not yet sufficiently advanced to enable him to speak with certainty about it. His experience so far had taught him that ozonised air, passed through a coloured syrup for three hours, produced as much decolourising effect as contact with animal charcoal for twenty-four hours. His experiments had been unavoidably discontinued for a time, but he hoped shortly to return to them.

Professor WILLIAMSON hoped that some gentleman present might be able to give some information upon one point, which had been but slightly touched by Dr. Wallace, and which yet was of great importance. He alluded to the relation believed to subsist between the soluble salts of the raw sugar and the crystallisable sugar prevented by them from crystallising.

The PRESIDENT asked Dr. Williamson whether he supposed that these soluble salts merely retained the sugar, or whether they changed it in any way.

Professor WILLIAMSON said that his own information upon the subject was mainly derived from experiments made by another gentleman in his laboratory, and he did not feel justified in going into particulars of them. Some salts appeared to possess the property of retaining sugar in solution, while others had an opposite property, and actually accelerated its crystallisation.

Dr. VOELCKER remarked that beet-root sugar often contained a good deal of common salt. Now, as beet-root contained no fruit sugar, and yet salt was present, it would seem to point out that chloride of sodium had not the effect of changing the nature of the sugar, but simply of preventing in some measure its crystallisation. That it had the latter power was well known, and sugar refiners dreaded its presence more than that of almost any other salt.

The meeting then adjourned to the 18th inst.

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

A MEETING was held in the Society's rooms, Andersonian Buildings, on Monday, the 1st inst, at eight o'clock in the evening, James Couper, Esq., St. Rollox Chemical Works, in the chair. One new member was admitted, and one candidate proposed.

A paper was read by P. M. MOIR, Esq., "On the Preservation of Timber," which we shall endeavour to give as fully as possible in our next.

FOREIGN SCIENCE.

PARIS, FEB. 10, 1869.

Patent for Murexide.—Topaz Deposit.—Electro-capillary Actions.—Proximate Constituents of Cotton Fibre.—Action of the Electric Spark on Marsh Gas.—Academy of Sciences.—The Solution of Sulphur.—Photographing on Enamel.—Hydrogen and Palladium.—Physiological Action of Conia, Ethylconia, and Iodide of Diethylconia.

A PATENT has been granted to MM. Kessler and Luxer for the preparation of uric acid, and the products employed in dyeing. Murexide is prepared according to two methods by the authors. In the first process, to a mixture of equal parts of commercial nitric acid and water, small portions of uric acid are added from time to time. At each addition, an action is manifest, and when too much uric acid is presented at once the temperature rises, and binoxide of nitrogen is disengaged. However, towards the finish, there is no fear of the liquid becoming too hot; on the contrary, it becomes necessary to aid the reaction by gentle heating, in order to dissolve all the uric acid possible. The more or less brown liquid thus obtained is filtered, and mixed in the cold with about an equal weight of ammonia. A red colouration and turbidity are caused; by the heat of a water bath abundant crystals of murexide are deposited, and the mother liquor, by evaporation, yields a reddish brown dry mass. In the second process the authors act on solutions of alloxan with ammonia salts of reducing acids, giving the preference to formiate of ammonia, the operation succeeds, likewise, with oxalate, but not so well with acetate. It is better to use rather concentrated solutions of the two bodies and to employ heat. The ammoniacal salt is added so long as the liquid separated by cooling from murexide, and thereby decolourised, becomes coloured by the addition of a trace of the ammoniacal salt.

In a very difficultly accessible cave in the mountain of Galenstock, which separates the canton of Berne from that of Urich, a very rich deposit of topaz has been recently found, valued at more than 100,000 francs.

M. Becquerel in his sixth memoir "On Electro-Capillary Actions" describes the processes which he employed to obtain a great number of hydrated oxides in the crystalline state. In a vessel containing a solution of nitrate of copper, a smaller vessel, one side of which was composed of parchment paper, was placed, containing aluminate of potash. Nitrate of potash was produced but in the place of aluminate of copper; in the porous vessel crystals of hydrated alumina presented themselves, and on the outside crystals of hydrated oxide of copper formed. By replacing the aluminate of potash by silicates, M. Becquerel obtained hydrated silica sufficiently hard to scratch glass.

M. Berthelot has examined the action of the electric spark on marsh gas. When a succession of powerful sparks is made to traverse pure marsh gas, carbon is deposited and the volume of gas augments considerably. Operating with 100 c.c., this volume becomes 127 c.c. at the end of two minutes, 154 c.c. at the end of ten minutes, and so on; but some hours are required for the complete destruction of the marsh gas. That no marsh gas remains at the end of the experiment may be demonstrated, after removing the acetylene and the traces of condensed vapours which are present mixed with hydrogen. According to received theories, the volume of marsh gas should become double, since it is resolved into hydrogen and carbon:—$C_2H_4 = C_2 + 2H_2$. The experiment does not agree with these theories, 100 volumes of marsh gas furnishing only 181 volumes in two concordant determinations. Acetylene constitutes 13·5 to 14 per cent of the products; the half of the marsh gas is transformed into acetylene by the action of the spark:—

$$2C_2H_4 = C_4H_2 + 3H_2.$$

At the commencement of the experiment the acetylene formed corresponds to an almost complete transformation of the marsh gas, but the proportion of acetylene formed from the marsh gas is smaller in proportion to the amount of acetylene present. Therefore, by arresting the experiment for a few minutes, and absorbing the acetylene, it should be possible to push the action further. M. Berthelot has been able in this way to form 39 volumes of acetylene from 100 volumes of marsh gas; these figures show that four-fifths of the marsh gas was converted into acetylene. The conversion of marsh gas into acetylene does not explain directly why the volume of gas is not doubled under the influence of the spark. In fact, the formation of acetylene, as well as carbon, corresponds to a double volume; but acetylene under the influence of heat passes into condensed hydro-carbons. Thus, it is easy to detect the presence of triacetylene or benzol vapour in the gaseous products of the reaction, by agitating with fuming nitric acid. By reason of these condensations, a part of the hydrogen remains combined in the heavy vapours or fixed compounds, thus diminishing the volume of free hydrogen. Half of the marsh gas is converted into acetylene, 3-8ths into condensed hydro-carbons, and 1-8th simply into carbon and hydrogen. These results point to a similarity in the action of the spark and that of heat. The prolonged action of a dull red heat ends in nearly the whole of the acetylene being condensed, even in the presence of a large excess of hydrogen. The electric spark, however, only acts on the acetylene when pure, or mixed with less than six times its volume of hydrogen.

At the meeting of the Academy on the 11th of January, M. Lefort contributed a note on the solution and estimation of sulphur by means of aqua regia, and M. Duchemin a note on photographing on enamel.

The enamel used for painting and photography is composed principally of silica, oxide of tin, and oxide of lead; the mixture is melted on copper, gold, or platinum. Besides the high price, the enamel produced in this way is defective in not possessing a flat surface, in consequence of which the photographer is obliged to transfer the image on to the enamel. Crown glass covered with a fusible enamel, having arsenic for the base, can replace very economically the surfaces obtained by the more expensive method. M. Duchemin gives the processes most suitable for this branch of photography.

M. Lefort describes the action of aqua regia on sulphur to be, firstly, the formation of chloride of sulphur; secondly, the destruction of this compound by nitric acid or its derivatives; and consequently the regeneration of the chlorine, the evolution of nitrous vapours, and the formation of sulphuric acid. In proportion to the amount of nitric acid present, is the solution of the sulphur quickly arrived at. The most convenient mixture of hydrochloric and nitric acids for dissolving sulphur, is made with 1 volume of the former and 3 of the latter.

At the meeting on the 18th of January, a memoir was communicated by Professor Graham, on hydrogen in its relations with palladium, a memoir with which your readers are already acquainted. M. Wurtz, in commenting upon the results set forth in this memoir, remarked that he had formerly attempted to prepare a hydride of palladium by the process which enabled him to prepare a definite combination of hydrogen and copper, viz., the reduction of sulphate of copper by hypophosphorous acid. When an excess of a solution of this acid is added to the solution of a palladium salt the liquid becomes turbid, and in a few minutes a finely divided brown precipitate is deposited. Nearly immediately, and even at 0°, an evolution of hydrogen is manifest, and if heated the evolution of gas becomes very brisk. As soon as the hydrogen ceases to come off the liquid begins to clear, and the precipitate now appears black and flocculent—this precipitate is palladium. From these facts it would seem that the pulverulent and amorphous palladium precipitated by hypophosphorous acid is incapable of retaining hydrogen.

The only other memoir we have to notice from this meeting is one by MM. Pélissard, Jolyet, and A. Cahours, on the physiological action of ethylconia and the iodide of diethylconia compared with that of conia. Ethylconia and the iodide of diethylconia lead, like conia, to a rapid poisoning of the pneumogastric nerves, differing at the same time in possessing a less energetic and more passing action on the voluntary nerves. In equal conditions, conia is more poisonous than ethylconia, which is again more poisonous than the iodide of diethylconia. Thus, a relatively longer time is required for ethylconia to destroy nervous excitability than for conia, and with the iodide of diethylconia, the movements of the nerves are never more than weakened. It is a fact worthy of remark that the introduction of the radical ethyl with the conia abolishes the period of convulsions which precedes the paralysis in poisoning by this alkaloid: the fact is particularly seen in poisoning by iodide of diethylconia, where the animal falls incapable of making voluntary movements, without this paralysis being preceded by the slightest convulsions.

Thus the introduction of ethyl with conia produces similar results to the introduction of this radical into strychnia.

OBITUARY.

Baron Von Reichenbach.—This philosopher died recently at Leipzig, aged 81. His researches on the products of the destructive distillation of coal and wood, and his great work on meteorites, are well known to our readers. His investigations on the supposed new *odylic* force, also deserve notice as a remarkable instance of philosophic enquiry applied to subjects scarcely yet within the grasp of scientific reasoning.

CORRESPONDENCE.

CHEMICAL AFFINITY AND ELECTRICITY.

To the Editor of the Chemical News.

Sir,—A course of experiments on electric decomposition has led me to a line of thought which appears to promise a great simplification of chemical and electric theory.

We are accustomed to speak of bodies as being formed and held together by the strength of chemical affinity and decomposed by virtue of a stronger; thus silver dissolves in nitric acid because of their affinity, while copper displaces the silver, and zinc in turn the copper, by their relatively greater affinities for the acid.

We also suppose that the galvanic current effects decomposition by means of its greater force, attacking the

molecule and overcoming the affinity which holds it together; in fact, by a conflict in which the strongest force conquers.

Is not the true theory exactly the reverse in both cases? In the example noted, the silver in dissolving gives out heat; the copper in precipitating does the same, and the zinc repeats the process, the three heats together being equal to that which the zinc alone would give in dissolving. Now surely the loss of heat cannot be an indication of increased forces.

Among the old subdivisions of affinity, predisposing affinity played a great part in chemical reactions. Now, as heat has a strong tendency to radiate away into space, is it not highly probable that this is the predisposing cause of chemical reactions—that bodies will combine together, or alter their forms of combination whenever the latent heat essential to the new form is less than that of the old, and the conditions permit the free motion of the atoms and the setting free of heat?

In this light the amount of heat set free in any action is the measure of the so-called affinity at work; this is already well-known as a fact, but hitherto it has been treated as a mere incidental consequence of the reaction. Is it not rather the sole effective cause?

This view gives at once a clear explanation of the decomposing action of the galvanic current. It is well known that different substances present different resistances, and therefore require varying electro-motive force in the current, and the reason is, not that the force of affinity has to be subdued, but that to enable the elements of a compound to resume their separate forms, we must re-charge their atoms with the amount of force they lost in the act of combining. This is done by the electric current, whenever each molecule, the pulsations of which constitute the current, is charged to the necessary degree, and unless the electro-motive force is raised to that degree, the molecules cannot move or the current pass. The same effect is produced by heat, only when its temperature is raised to the corresponding degree, when the molecules become charged with the force necessary to their separate existence; then, if other circumstances are such as to permit the component elements to be removed from each other and thus prevent immediate recombination, the force becomes latent and decomposition is effected.

Thus chemical combination is due to the loss or escape of combined or latent force. Chemical decomposition is due to force becoming latent or attached to the atoms.

This view of force brings into relation many things at present looked upon as exceptional, and furnishes a general law for all chemical phenomena; thus it shows why reactions always occur when an insoluble substance, or a less soluble one can be produced, because that implies less latent heat, and it explains the difficulties of dissociation of vapours, because that must occur when the temperature charges the atoms with the force necessary to their separate existence, though if not separated, they reunite as soon as the temperature falls below that point. —I am, &c.,

John T. Sprague.

THE NEW PETROLEUM ACT.

To the Editor of the Chemical News.

Sir,—In answer to many inquiries, as well as to the question by "A Wholesale Firm," in your last issue, allow me to state that benzol, as a mineral product, unquestionably comes under the act. Ether, as a vegetable product, does not; hence, doubtless, the deduction will be drawn that dealers in ether should be allowed to sell the less dangerous benzol without restriction—that, in fact, pharmacists should have been exempted from the operation of the new law. But it is the public, not chemists, who are to be educated to recognise the inflammable properties of these lamp oils and spirits, and as the public frequently, except in large towns, purchase such materials of pharmacists, exemption of the latter would have been most mischievous.

Wholesale and retail chemists and druggists will find that the act itself does not cause an unreasonable amount of trouble in requiring them to carry out its praiseworthy object of further protecting life and property from fire. Local licensing bodies, however, who are just now making regulations as to the storage of petroleum by oilmen, may unconsciously cause a vast deal of annoyance to those pharmacists who do not sell burning oils in any form, and only benzol and petroleum in little bottles under the name of glove-cleaning liquids. It is for such gentlemen, or, perhaps, the Pharmaceutical Society in their name, once for all to memorialise the Home Secretary with a view to the adoption of some rule whereby local conditions of licence, which are unnecessarily irksome to pharmacists, may be modified in the case of persons not dealing in lamp oils. Clause 6 of the Petroleum Act of 1862, which is read as one with that of 1868, specially provides this course in anticipation of difficulties such as those above mentioned. —I am, &c.,

The Professsor of Practical Chemistry to the Pharmaceutical Society, and London Analyst to the Fire Offices.

MISCELLANEOUS.

How to Make Claret.—At the meeting of the Polytechnic Association of the American Institute on the 7th of January, during a discussion on the adulteration of wines, Dr. Van der Weyde is reported by the *American Artisan* to have described a mode of making claret, viz., by allowing water to soak through shavings, and adding thereto a certain proportion of logwood and tartaric acid. This produced a wine hardly to be distinguished in flavour and colour from claret.

Coloured Socks again!—The following advertisement appeared in Tuesday's *Times*:—"Sock and Shirt Poisoning.—A committee having been formed for the purpose of fully investigating the above subject, all persons who have suffered from wearing coloured socks or other coloured surface clothing are requested to send statements of their cases, with a portion of the garments from wearing which they have so suffered, to the honorary secretary, Emil Pohl, Esq., No. 15, Fenchurch-street, London, E.C. Medical gentlemen will also greatly oblige the committee by the particulars of cases that have come under their observation, with any comment they may have to offer."

The Heaton Steel and Iron Process.—We insert the following abridgment of an article from *Engineering*, but without endorsing the opinions there expressed. A long article on the subject is in preparation and will appear in our pages next week:—

"Careful and unquestionable analyses lately made by Professor Dr. W. A. Miller, showed that the initial product of the so-called 'Heaton steel process' was neither iron nor steel in any form immediately applicable to use. The crude product, by repeated heating and hammering, or rolling, could be brought to the stage of an iron of inferior quality, but probably at a cost greater than that necessary for making equally good iron from puddled bar, which of itself is cheaper than the crude product of the nitrate process. The 'Heaton process' never produced an ounce of steel, nor anything resembling it, but merely an inferior iron from which an inferior steel could be afterwards made by the usual process of melting along with carbonising substances. In saying this it should also be said that, hoping against hope, it had been widely, if not generally, wished that Mr. Heaton's representations were true, and that all his expectations would be realised. It is easy for those having no practical knowledge of a subject to place their faith in chance and the possibilities

of discovery, but every inch of ground entered upon anew at 'Langley Mill' had been explored long ago, and without profit. The main gist of the paper, the first few lines of which have been quoted, is to prove that, notwithstanding an enormous amount of puffing in divers papers and periodicals, to make the process known and to set forth its immense value, it has proved a signal failure also in respect of obtaining subscribers to form a limited liability company. To some of the few shareholders in this concern has been issued a printed 'cost-sheet,' wherein it is certified that the actual results of making steel by the Heaton process, at Langley Mill, is something between £5 and £6 per ton; while every steel maker knows that this is about the cost of mere conversion of wrought-iron into cast-steel, saying nothing of the cost of the iron itself, which must be of superior quality. The furnace in which Mr. Heaton professes to melt steel at a cost for *coal* (not coke) of 5s. per ton was never built. It is, presumably, the wonderful furnace patented by him, which furnace could not, by any human possibilty, melt steel at all, and still less, were that possible, could it melt wrought-iron, which Mr. Heaton must employ in making steel according to the common process. Were his presumed impracticable furnace capable of melting wrought-iron, were it in fact available for steel making, it would not even then have any relation whatever to the so called Heaton process of converting pig-iron, but would constitute a distinct invention, which the Sheffield steelmasters would be glad to adopt, if they could feel perfectly assured of the truth of Mr. Heaton's statements, as to the melting of a ton of steel by some 17 cwts. of coal at a cost of 5s. It appears more and more, as might be almost *à priori*, stated by men thoroughly conversant with the metallurgical processes, approved of by a long experience, that the nitrate-steel process could never realise what has been too imprudently asserted as to its merits and technical value."

NOTES AND QUERIES.

Dissociation.—In studying the phenomena of dissociation, Berthelot has discovered that sulphide of carbon is decomposed into sulphur and carbon at the same temperature at which S and C unite to form sulphide of carbon.—*Engineer.*

Utilisation of Waste Heat.—Can any of your courteous readers inform me whether the waste heat from coke ovens has ever been utilised (under patent) in the alkali manufacture, either for the raising of steam, evaporation, or in decomposing furnaces?—W. F. K. Stock.

Soap-Tablet Stamping Machine.—A subscriber would be glad to hear of the proper parties for supplying soap-tablet stamping machines and dies. He has read articles on the subject in Muspratt, and also in Richardson and Watts; but it is probable that there is something better in use than any machine described there. Who would be the likeliest engineer to supply what is required?

Action of Cyanogen on Hydrochloric Acid.—Messrs. R. Schmidt and Glutz have recently made a very beautiful experiment. When a current of gaseous cyanogen is passed into hydrochloric acid, as concentrated as possible, no colouration is observed, but after twelve hours crystals of oxamide make their appearance, and the supernatant liquid contains oxalate of ammonia. With iodhydric acid the result is the same; oxamide is likewise formed, but iodine is displaced, and the liquid is found to contain hydrocyanic acid and iodide of ammonium.—*Engineer.*

Spontaneous Combustion of Silk.—M. J. Persoz has read a paper "On the Spontaneous Combustion of Silk." It is well known that silk, which, in the operations of bleaching, cleansing, &c., loses considerably in weight, can be made to fill up again, or can be charged (especially black silk) so that the material will actually gain 100 to 300 per cent in weight by this treatment. The substances usually employed for this purpose are astringents, such as catechu, gall nuts, and certain salts, especially protosulphate of iron. A charged silk of this description was found to contain 22 per cent of water, and from 11·0 to 11·5 per cent of impurities. When dried at 110° to 115° C., it took fire spontaneously as soon as air got free access to it. This effect appears to be owing to the rapid absorption of moisture, during which oxidation occurs as rapidly.

The New Petroleum Act.—According to the definition as read in the act there can be no doubt whatever that benzol is among the substances alluded to, *i.e.*, intended to be within the category of those substances which are recited in the act; I have seen that a dealer in gloves has made application for a license to be allowed to keep on his premises in Regent Street 20 gallons of benzol.—Dr. A. A.

The New Petroleum Act.—In reference to the enquiry of your correspondents, "A Wholesale Firm," whether benzol comes under the operation of this act, I beg to say that the definition in clause 3 of "Petroleum," that it will be illegal to keep (otherwise than for private use) without a license, or to sell, unless the vessel containing such material have attached to it a precautionary label, includes *any oil made from coal*, schist, shale, peat, *or other bituminous substance* and *any product of them* giving off an inflammable vapour at a temperature of less than 100° F. Unless the naphtha of gas-tar cannot be regarded as an "oil," it would appear to be comprised in this definition as being a product of coal, and as giving off an inflammable vapour below 100° F. Benzol, likewise, though it may not be strictly an "oil," is, nevertheless, a product of coal, or, at any rate, of a bituminous substance—the tar of gas works—and therefore it would appear to come under the provisions of the Petroleum Act, whether kept or sold in large quantities for the manufacture of colours and other purposes, or in smaller quantities as a material for removing grease spots, &c. Though ether and spirit of wine both give off inflammable vapour below 100° F., they are not products of any of the materials specified in the 3rd clause of the act, and therefore would not come under its provisions.—Benjamin H. Paul, 8, Gray's Inn Square, Feb. 8, 1869.

MEETINGS FOR THE WEEK.

Monday, 15th.—Medical, 8.
—— London Institution, 6.
Tuesday, 16th.—Royal Institution, 3. Mr. Westmacott, "On Fine Art."
Wednesday, 17th.—Meteorological, 7.
—— Society of Arts, 8.
Thursday, 18th.—Royal Institution, 3. Dr. M. Foster, "On the Involuntary Movements of Animals."
—— London Institution, 6.
—— Royal, 8.30.
—— Zoological, 4.
—— Chemical, 8.
—— Royal Society Club, 6.
Friday, 19th.—Royal Institution, 8. Mr. Greville Williams, "On the Female Poisoners of the Sixteenth and Seventeenth Centuries."
—— Geological, 8. Anniversary Meeting, 1.
Saturday, 20th.—Royal Institution, 3. Dr. Odling, F.R.S., "On Hydrogen and its Analogues."

TO CORRESPONDENTS.

*** Dr. Odling's "Lectures on Carbon."—Owing to press of matter, the publication of these lectures is unavoidably suspended for this week.

Chemicus.—We know of no good work on the manufacture of pigment colours. Perhaps some correspondent could inform us if there is one.

Calcium.—A table of equivalents and a rule-of-three sum will answer the question as well as we could.

J. T. S.—The letter was unavoidably left standing over for some weeks, owing to great press of matter.

J. Sutherland.—We cannot give the information at present, but will insert the substance of your query.

J. W.—1. Doubtless there would be a little more demand for sodium at 3s. per pound than there is at present; but we do not think it would be worth any one's while to make it for that price, were the demand double what it is now. 2. Messrs. Roberts, Dale, and Co. hold the patent—apply to them. 3. The patent itself can be procured from the Patent Office for a few pence.

G. E. D.—1. Either the conversion of the benzol was incomplete, or the liquid you experimented upon was not benzol. There is no difficulty in making nitrobenzol from good materials. 2. As you are a student of chemistry, take our advice, and leave atoms and molecules alone for the present. Nobody knows how the atoms are arranged in elements of different atomicities. Graphic formulæ, diagrams, &c., are only artificial aids to fix certain properties of bodies on the memory; but no one intends them to represent the architectural plan and elevation of the body. Avoid theory: stick to experiment. 3. A compound, NH_4, is said to have been isolated. See the article, "Ammonium," in Watts's "Dictionary."

Communications have been received from Dr. R. Angus Smith, F.R.S.; J. J. Lish; L'Abbé Moigno; Dr. Adriani; J. J. Griffin and Sons; Dr. Rührig; J. Spiller; Prof. Heaton; W. H. Perkin, F.R.S.; R. R. Tatlock; W. F. R. Stock; Stevens, Bros.; C. G. Williams, F.R.S.; J. Watson; J. Sutherland; J. T. Sprague; J. Heywood; Drogheda Chemical Manure Works (with enclosure); Longmans and Co.; Dunn and Co.; Tennant and Co.; Dr. S. Muspratt; J. T. Bouck (with enclosure); W. Little; F. S. Jerningham (with enclosure); W. Blythe (with enclosure); Calvert and Co. (with enclosure); Demuth and Co.; H. Smith; F. A. Pooley (with enclosure); W. Hunter (with enclosure); W. E. Bickerdike (with enclosure); and C. Hunter.

BOOKS RECEIVED.

Annual Report of the United States Patent Office for the year 1866, from the Honourable the Commissioner of Patents, Washington.

THE CHEMICAL NEWS.

VOL. XIX. No. 481.

HEATON'S STEEL AND IRON PROCESS
IN ITS PRESENT STATE.

THE great and general interest created by Heaton's process is proportionate with its great scientific and commercial object, which is nothing more or less than the production of good useful steel and wrought-iron from impure pig-iron. The use of impure pig is the chief point which distinguishes Heaton's process from other old and modern steel processes, as these have all required the employment of pure iron, or iron ore especially free from phosphorus and sulphur; this requirement very much limits the application of the otherwise highly valuable process of Bessemer.

Heaton's process differs from Bessemer's in employing nitrate of soda as the oxidising agent instead of atmospheric air, and both processes aim at the conversion of large masses at a time. As the great majority of existing iron works produce iron more or less contaminated with phosphorus and sulphur, Heaton's process would find an extensive field of operation if it were found fully to come up to what its promoters profess.

Our present knowledge of the process is confined to experiments only, the results of which are stated in reports (partly preliminary) by Professor Miller, Dr. Mallet, and Mr. Kirkaldy, and also in public correspondence; from these sources we are obliged at present to obtain our information and to form our opinion, as we have not ourselves seen the working of the process.

Prof. Miller's preliminary report describes Heaton's process thus:—

"On the occasion of our (namely, his and Dr. Mallet's) visit to the works of Langley Mill, on the 10th of July, 1868, 6¼ cwts. of Clay Lane forge pig, No. 4, were charged into a hot cupola which contained no other iron; and immediately 6¼ cwts. of Stanton forge pig, No. 4 (produced from ⅜ of Northamptonshire brown ore, ⅛ of Chesterfield clay ore, and ⅜ of puddling cinder) was added, and the whole, when melted, was drawn off into a ladle, from which it was transferred to the *converter*.

"The 'converter' is a wrought-iron pot, lined with fire-clay. In the bottom of it was introduced a mixture of 169 lbs. of crude nitrate of soda, 40 lbs. of siliceous sand, and 20 lbs. of air-slaked lime; but these proportions in practice are varied considerably. On the top of this mixture a cast-iron perforated plate, weighing 95 lbs., was placed. The converter was then securely attached to the open mouth of a sheet-iron chimney, and the melted iron from the cupola (sample of this marked No. 4) was poured in.

"In about two minutes a reaction commenced; at first a moderate quantity of brown nitrous fumes escaped, these were followed by copious blackish, then grey, then whitish fumes, produced by the escape of steam carrying with it, in suspension, a portion of the flux. After the lapse of five or six minutes, an intense deflagration occurred attended with a loud roaring noise, and a burst of a brilliant yellow flame from the top of the chimney. This lasted for about a minute and a half, and subsided as rapidly as it commenced. When all had become tranquil, the converter was detached from the chimney, and its contents were emptied upon the iron pavement of the foundry.

"The crude steel was in a pasty state and the slag fluid; the cast-iron perforated plate had become melted up and incorporated with the charge of molten metal.

"The slag had a glassy, blebby appearance, and a black or dark green colour in mass.

"A mass of crude steel from the converter was then subjected to the hammer (No. 7).

"About 4½ cwts. of the crude steel were transferred to an empty, but hot reverberatory furnace, where, in about an hour's time, it was raised to a welding heat, and forged into four blooms under the steam hammer, then rolled into square billets, which were cut up, re-heated, and rolled into finished bars, varying in thickness from 1 inch to ⅛ of an inch (No. 8).

"Three or four cwts. of the crude steel from the converter were transferred to a re-heating furnace, then hammered into flat cakes, which, when cold, were broken up and sorted by hand for the steel melter (No. 9).

"Two fire-clay pots, charged with a little clean sand, were heated, and into each 42 lbs. of the cake steel were charged. In about six hours the melted metal was cast into an ingot (10 B)

"Two other similar pots were charged with 35 lbs. of the same cake steel, 7 lbs. of scrap iron, and 1 oz. of oxide of manganese. These, also, were poured into ingots (10 C).

"The steel, 10 B and 10 C, was subsequently tilted, but was softer than was anticipated.

"These results, on the whole, are to be considered rather as experimental than as average working samples.

"I have, therefore, made an examination of the followin samples only:—

No. 4.—Crude cupola pig.
,, 7.—Hammered crude steel.
,, 8.—Rolled steely iron.
,, 5.—Slag from the converter.

"I shall first give the results of my analysis of the three samples of metal:—

	Cupola Pig No. 4.	Crude Steel (7).	Steel Iron (8).
Carbon	2·830	1·800	0·993
Silicon with a little titanium	2·950	0·266	0·149
Sulphur	0·113	0·018	traces
Phosphorus	1·455	0·298	0·292
Arsenic	0·041	0·039	0·024
Manganese	0·318	0·090	0·088
Calcium	—	0·319	0·310
Sodium	—	0·144	traces
Iron (by difference)	92·293	97·026	98·144
	100·000	100·000	100·000

"It will be obvious from a comparison of these results that the reaction with the nitrate of soda has removed a large proportion of the carbon, silicon, and phosphorus, as well as most of the sulphur. The quantity of phosphorus (0·298 per cent) retained by the sample of crude steel from the converter which I analysed, is obviously not such as to injure the quality.

"The bar-iron (No. 9) was, in our presence, subjected to many severe tests. It was bent and hammered sharply round without cracking. It was forged and subjected to a similar trial, both at a cherry red and at a clear yellow heat, without cracking; it also welded satisfactorily.

"The removal of the silicon is, also, a marked result of the action of the nitrate.

"It is obvious that the practical point to be attended to is to procure results which *shall be uniform*, so as to give steel of uniform quality when pig of similar composition is subjected to the process. The experiments of Mr. Kirkaldy on the tensile strength of various specimens, afford strong evidence that such uniformity is attainable.

"I have not thought it necessary to make a *complete* analysis of the slag, but have determined the quantity of sand, silica, phosphoric and sulphuric acid, as well as the amount of iron it contains. It was less soluble in water than I had been led to expect, and it has not deliquesced, though left in a paper parcel.

"I found that of 100 parts of finely-powdered slag, 11·9 were soluble in water. The following was the result of my analysis:—

Sand	47·3
Silica in combination	6·1
Phosphoric acid..	6·8
Sulphuric acid	1·1
Iron (a good deal of it as metal) ..	12·6
Soda and lime	26·1
	100·0

"The result shows that a large proportion of phosphorus is extracted by the oxidising influence of the nitrate, and that a certain amount of the iron is mechanically diffused through the slag.

"The proportion of slag to the yield of crude steel was not ascertained by direct experiment, but, calculating from the materials employed, its maximum amount could not have exceeded 23 per cent of the weight of the charge of molten metal. Consequently, the 12·6 per cent of iron in the slag could not be more than 3 per cent of the iron operated on.

"In conclusion, I have no hesitation in stating that Heaton's process is based upon correct chemical principles. The mode of attaining the result is both simple and rapid. The nitric acid of the nitrate in this operation imparts oxygen to the impurities always present in cast-iron, converting them into compounds which combine with the sodium, and these are removed with the sodium in the slag. This action of the sodium is one of the peculiar features of the process, and gives it an advantage over the oxidising methods in common use."

The following is Dr. Mallet's opinion of the reality and and commercial value of Heaton's process.

"This process for converting crude pig-iron into wrought-iron and into steel, by the employment of nitrate of soda, in Heaton's patent converter, has been repeated at Langley Mills many times, in my presence. I have examined minutely into its details as applicable in practice on a large scale, and its results; and I have also considered the chemical researches made as to the materials used and products obtained, by Professor Miller, of King's College, and I have been present at experiments, conducted by Mr. David Kirkaldy, at his Testing Works, at Southwark, as to the physical qualities of the products which were obtained by this process, in my own presence, at Langley Mills. In view of all the facts that have come before me, I can affirm the following as truths established beyond question:—

"1st. That Heaton's patent process of conversion by means of nitrate of soda, is at all points in perfect accord with metallurgic theory. That it can be conducted upon the great scale with perfect safety, uniformity, and facility, and that it yields products of very high commercial value.

"2nd. That in point of manufacturing economy or cost it can compete with advantage against every other known process for the production of wrought-iron and steel from pig-iron.

"3rd. Amongst its strong points, however, apart from and over and above any mere economy in the cost of production are these:—It enables first-class wrought-iron, and excellent steel to be produced from coarse, low-priced brands of crude pig-irons, rich in phosphorus and sulphur, from which no other known process, not even Bessemer's, enables steel of commercial value to be produced at all, nor wrought-iron, except such as is more or less either "cold-short" or "red-short." Thus, wrought-iron and cast-steel of very high qualities have been produced, in my presence, from Cleveland and Northamptonshire pig-irons rich in phosphorus and sulphur, and every iron-master, I presume, knows that first-class wrought-iron has not previously been produced from pig-iron of either of these districts, nor marketable steel from them at all.

"Heaton's process presents, therefore, an almost measureless future field in extending the manufacture of high class wrought-iron and excellent steel into the Cleveland, and other great iron districts, as yet precluded from the production of such materials by the inferior nature of their raw products. It admits of the steel manufacture also being extended into districts and countries where fuel is so scarce and dear that it is otherwise impossible.

"I cannot, in this brief communication, point out the prospects which the employment of this system presents of greatly diminishing the existing waste of material, fuel, time, and wages, in the puddling process, and of lessening difficulties in relation to labour questions which beset that process, injuriously to the British iron trade. Nor can I adequately point out the large reduction in the original outlay for plant which this system admits of as compared with any other for equal annual out-put of iron and steel.

"Dr. Miller has proved, incontrovertibly, that the Heaton process does eliminate from the crude pig-iron almost the whole of the phosphorus and sulphur, the trace remaining being unobjectionable in the wrought-iron and steel produced, even when they have been made from the pig-irons known to be the richest in these injurious constituents of any make in Great Britain.

"The wrought-iron made in my presence from Cleveland and Northampton pigs and tested for tensile resistance also before me, bore a rupturing strain of 23 tons per square inch, and an elongation of nearly ¼ of the original unit in length. It is therefore iron of great strength and toughness, and yet probably by no means the very best that this process is capable of producing hereafter. It possesses those qualities which best fit iron for artillery, armour plates, and iron ships or boilers.

"The tilted cast-steel also made in my presence, from the very same pig-irons as the above, bore a tensile strain at rupture of above 42 tons per square inch with an elongation of $\frac{1}{12}$th of the unit of length. It is, therefore, a remarkably tough and fine quality of steel, well suited for rails, ship-building, and all other structural uses. In a word, steel suited for any purpose known to the arts can be produced by this system from very inferior brands of pig-iron, from such as by no other known process could serviceable steel be made at all."

Mr. Kirkaldy has tested not only the bars of steel and steel-iron made in the presence of Dr. Miller and Dr. Mallet, but a number of other bars made by Heaton's process from different brands of pig-iron. The results of these experiments are given in the following tables:—

Description.	Mean Breaking Weight per square inch. lbs.	tons.	Contraction of Area. p.c.	Extension in 10 inches. p.c.	Appearance of Fracture.
1. Hammered cast-steel—made in the presence of Messrs. Miller and Mallet. Average of 5 samples	95,414	42·6	9·3	7·7	granular.
2. Ditto—made from 13 cwts. *Glengarnock Pig*, No. 2 (Scotch). Average of 2 samples	99,481	44·4	16·9	8·5	55 p.c. silky; 45 p.c. granular.
Average of 2 samples	84,877	37·8	3·9	4·1	granular. (peculiar).
3. Ditto—made of 7 cwts. of *Workington Pig*, No. 1, and 6 cwts. of *Stanton Forge Pig*, No. 4, mixed in the cupola in the usual way. Average of 3 samples.	92·961	41·5	13·9	7·6	granular (the weakest of the 3 sample bars was 75 p.c. silky.)
4. Ditto—made from a charge of *Round Oak Pig-iron* only; the quantity of nitrate of soda used was 10 p.c. Average of 6 sample bars (0·77 × 0·78)	90,478	40·4	1·9	1·0	granular.

DESCRIPTION.	MEAN BREAKING WEIGHT PER SQUARE INCH. lbs.	tons.	CONTRACTION OF AREA. p.c.	EXTENSION IN 10 INCHES. p.c.	APPEARANCE OF FRACTURE.
5. Ditto—made from a charge of 13 cwts. of *Butterleg Iron*, with 10 p.c. of nitrate of soda; 8 bars were made from the cakes melted in the crucible, and tilted into 4 bars of 1 in. and 4 bars of ½ in. squares. Average of 4 bars of ½ in. square..	100,019	44·7	11·4	5·5	granular.
Average of 4 bars 1 in. square	85,964	38·3	3·1	2·6	ditto.
6. Ditto—made from a charge of 13 cwts. of *Dowlais Iron* (No. 2), with 10 p.c. of nitrate of soda; 8 bars were made from the cakes melted in the crucible, and tilted in 4 bars of 1 in. and 4 bars of ¾ in. square. Average of 4 bars ¾ in. square ..	95,470	42·6	3·2	2·5	granular.
Average of 4 bars 1 in. square	82,438	36·8	2·3	1·3	ditto.
7. Ditto—made from a charge of 13 cwts. of *Dowlais Pig Iron* (No. 3), with 10 p.c. of nitrate of soda; 12 bars were made from cakes melted in the crucible, and tilted into 4 bars of 1 in., ¾ in., and ½ in. square. Average of 4 bars ½ in. square ..	112,875	50·4	7·6	2·3	granular.
Average of 4 bars ¾ in. square	91,096	40·7	2·9	1·2	ditto.
Average of 4 bars 1 in. square	79,480	35·5	2·0	0·8	ditto.
8. Ditto—made from a charge of 13 cwts. of *Middlesboro'* (No. 4) *Forge Pig Iron*, with 10 p.c. of nitrate of soda; 12 bars were made from cakes melted in the crucible, and tilted into 4 bars of 1 in., ¾ in., and ½ in. square. Average of 4 bars ½ in. square ..	119,699	53·4	18·3	10·3	granular (peculiar).
Average of 4 bars ¾ in. square	99,938	44·7	5·8	4·2	ditto.
Average of 4 bars 1 in. square	96,713	43·2	5·8	4·4	ditto.
9. Ditto—made from pure *Workington Hæmatite Pig Iron*, with 7½ p.c. of nitrate of soda; 6 bars ½ in. square made as the other bars before tested. Average of the 6 bars	108,489	48·4	5·8	2·7	granular.
10. Ditto—made from White Forge Pig, produced from oolite ore, at the works of Baron d'Adelswärd, at Longwy, Moselle, France. The charges of nitrate of soda were as under.					

No. I.

	c.	qr.	lb.
Longwy White Forge Pig	14	2	0
Perforated plate, Clay Lane	1	0	0
	15	2	0
Nitrate of Soda ..	1	1	10

DESCRIPTION.	MEAN BREAKING WEIGHT PER SQUARE INCH. lbs.	tons.	CONTRACTION OF AREA. p.c.	EXTENSION IN 10 INCHES. p.c.	APPEARANCE OF FRACTURE.

No. II.

	c.	qr.	lb.
Longwy White Forge Pig	14	2	0
Perforated plate, Clay Lane	1	0	0
	15	2	0
Nitrate of soda ..	1	0	26

No. III.

	c.	qr.	lb.
Longwy White Forge Pig	14	2	0
Perforated plate, Clay Lane.. ..	1	0	0
	15	2	0
Nitrate of soda ..	1	0	20

No. IV.

	c.	qr.	lb.
Longwy White Forge Pig	14	2	0
Perforated plate, Clay Lane.. ..	1	0	0
	15	2	0
Nitrate of soda ..	1	0	1½

12 bars of ½ in. cast-steel were made from No. 2 and No. 3 charges. Average of 6 bars	116,339	52·0	6·3	4·0	granular (peculiar).
Average of 6 bars ..	120,864	49·5	30·1	12·5	granular and silky.
11. Cast-steel, hammered, made from 3 charges of Grey Foundry Iron, produced at the works of M. de Wendel and Co., at Hayange, Moselle, France, from oolite ore, similar to the Northamptonshire ore, with charges of nitrate of soda in the following proportions:—					

No. I.

	c.	qr.	lb.
Hayange Grey Foundry Pig ..	14	2	0
Perforated plate of Cleveland Pig ..	1	0	0
	15	2	0
Nitrate of soda ..	1	1	10

No. II.

	c.	qr.	lb.
Hayange Grey Foundry Pig ..	14	2	0
Perforated plate of Cleveland Pig ..	1	0	0
	15	2	0
Nitrate of soda ..	1	2	2

No. III.

	c.	qr.	lb.
Hayange Grey Foundry Pig ..	14	2	0
Perforated plate of Cleveland Pig ..	1	0	0
	15	2	
Nitrate of soda ..	1	3	

Description.	Mean Breaking Weight per square inch.		Contraction of Area.	Extension in 10 inches.	Appearance of Fracture.
	lbs.	tons.	p.c.	p.c.	
The steel bars were made as before stated. Average of 4 bars ½ in. square	114,123	50·9	5·6	3·1	granular (peculiar).
Average of 4 bars ¼ in. square	112,590	50·3	5·6	3·2	ditto.
Average of 4 bars ⅛ in. square	84,740	37·8	2·6	1·3	ditto.
12. Cast-steel, hammered, made from a charge of 15 cwts. of white forge pig produced from oolite ore at the works of Baron d'Adelswärd, at Longwy, France, treated with 1 cwt. 25 lbs. of nitrate of soda. The 6 bars of steel were made from cakes melted in the crucible, and tilted into ½ in. square bars. Average of the 6 bars	109,951	49·1	8·7	6·0	granular.

Rolled steel-iron produced from the same kinds of pig-iron as the above-named, for the production of cast-steel, bore a rupturing strain of from 20·5 to 23·6 tons, and a contraction of area of from 14·2 to 49·6 per cent, and an extension of from 6·1 to 28·3 per cent. Hammered steel-iron of the same kind bore a rupturing strain of from 20·8 to 24·5 tons, a contraction of area of from 23·1 to 42·3 per cent, and an extension of from 11·3 to 23·6 per cent.

The following are the results of experiments on the tensile strength of various other kinds of iron and steel of known character made by Mr. Kirkaldy, and which we give here for the sake of comparison:—

Names.	Mean Breaking Weight per square inch. Tons.	Contraction of Area. Per cent.
a. Steel.		
Turton's cast-steel for tools (forged)	59·3	4·7
Jowitt's double shear steel (forged)	52·9	19·6
Bessemer's patent steel for tools (forged)	49·8	22·3
Wilkinson's blister steel (forged)	46·6	21·4
Krupp's cast-steel for bolts (rolled)	41·1	34·0
Jowitt's spring steel (forged)	32·4	24·1
Mersey Company's puddled steel (forged)	31·9	35·3
Blockairn puddled steel (forged)	28·0	11·9
b. Wrought Iron (round and square bars).		
Yorkshire Low Moor, Bowling, Farnley	27·5	49·8
Lanarkshire ◇ Govan ◇	26·0	49·4
Lancashire best rivet	24·0	48·6
Staffordshire charcoal (4)	25·6	60·9
,, BB scrap	26·5	52·0
Durham Best Best	23·9	18·3
Ditto	22·6	11·7
South Wales	18·5	9·8

When comparing these results with those obtained with Heaton's steel and iron it will be seen that Heaton's products are somewhat harder, as the contraction of area is generally greatest with the toughest and softest kinds. But on the whole the experiments before us are very satisfactory if we consider that Heaton's sample bars have been made experimentally only, and are consequently at a disadvantage with those of a regular manufacture, and if we further take into consideration the following circumstances influencing the tensile strength or tenacity of steel, and which can be followed better in a regular manufacture than in simple experiments:—

The Degree of Hardness.—Whilst a bar of unhardened good steel, 1 square inch (Prussian) in section, ruptures at a strain of 120,000 Prussian lbs. (wrought-iron bears only about 59,000 lbs.), the tenacity may be increased to 150,000 lbs. by properly hardening the steel. On the other hand, the tenacity decreases to 110,000 lbs. when the steel is hardened too much. The greatest hardness is therefore not combined with the greatest tenacity.

The Amount of Carbon contained in the Steel.—The cohesion of steel increases with its amount of carbon up to 1¼ per cent, but beyond this limit the tenacity again decreases.

The Mechanical Treatment of the Steel.—Steel will be stronger and more homogeneous the longer and the more frequently it is forged.

The nature of the raw materials employed, and consequently the foreign substances contained in steel, also exercise an influence on the quality.

Professor Miller has analysed the *steel iron*, whose tensile strength has been ascertained by Mr. Kirkaldy to be 23 tons per square inch, a statement by no means contradictory to the composition of the iron as shown by the analysis. We much regret that Professor Miller has not also made an analysis of the *hammered cast-steel* whose tensile strength was found by Mr. Kirkaldy to be 43 tons per square inch.

These bars of cast-steel are thus described in Dr. Mallet's certificate of identification:—

"I certify that certain round rolled bars of Heaton's Patent Steel Iron, marked and numbered, and also certain bars of *rolled cast-steel* and square bars of *tilted cast-steel*, also marked and numbered, were made on the 10th of of July, 1868, at Langley Mills Steel Works, by Mr. Heaton's patent process, in my presence, and in that of Dr. Miller (except in so far as that Dr. Miller, through illness, was unable to wait for *the 'pouring' and tilting, &c., of the cast-steel*), that the whole were made from a mixture of equal weights of Clay Lane No. 4 (Cleveland's) pig-iron, and of Stanton (BBB Pig) Northamptonshire iron, treated in Heaton's Patent Converter, and that the above bars of steel iron and cast steel were forwarded thence, in cases under my seal to Mr. Kirkaldy's Testing Works, London. That I there identified the said bars when taken out of the case in my presence, and that certain of those bars were tested before me as to the breaking strain and amount of elongation by Mr. Kirkaldy, and that the results of such testings are those referred to in my 'Preliminary Report.'"

These bars, therefore, most probably belong to the steel which Professor Miller's preliminary report designates as 10 B or 10 C, or the bars were perhaps taken from both kinds; neither of them has been analysed, although this appears to be absolutely required to clear up the doubt still hanging over Heaton's cast-steel, concerning its proportion of phosphorus. It is rather an enigma, that, in the controversy on the value of Heaton's process, which has been carried on for some time in different periodicals and newspapers, Professor Miller's analysis of the crude steel has been taken as a basis for judging the hammered cast-steel, which undoubtedly has a different composition and less impurities than the original crude steel. We perfectly coincide with the opinion that part of the impurities are contained in the crude steel as intermixed or disseminated slag, and it remains to be proved how far these impurities, especially phosphorus, have been eliminated by the subsequent treatment of crude steel as described by Drs. Miller and Mallet.

The elimination of phosphorus is said to be one of the striking features of Heaton's process, but Professor Miller's analyses would appear to show that, on this special point, Heaton's process has no advantage over the common puddling process.

According to Professor Miller's analyses, the pig-iron employed contained 1·455 per cent of phosphorus, which proportion was reduced in the crude steel to 0·298 per cent, and in the steel-iron to 0·292.

For the sake of comparison, we give the following results of the puddling process :—

I. According to analyses of Calvert and Johnson :—

	Fe.	C.	Si.	S.	P.
Pig-iron	94·052	2·275	2·720	0·311	0·645
Blooms	99·338	0·269	0·120	0·134	0·139
Finished iron..	99·490	0·111	0·088	0·094	0·117

II. The following is the result of Mr. Willis's analysis, made in Mr. Siemen's laboratory at Birmingham, of an inferior English pig-iron, before and after being puddled :—

Pig Metal.		Puddled Bars.	
Sulphur	0·08	Sulphur	0·017
Phosphorus	1·16	Phosphorus	0·237
Silicon	1·97	Silicon	0·200
Iron and carbon (by difference)	96·79	Iron (by difference)	99·546

III. In Ure's "Dictionary of Arts and Mines," ii., 726, the following illustrations are quoted :—

Pig-iron	3·030 per cent of phosphorus.	
Puddled bar ..	0·838	,,
Rough down bar	0·572	,,

The finished bar was cold-short in the highest degree.

	Phosphorus. Per cent.	Manganese. Per cent.
Pig-iron containing	2·60 ..	7·20
Puddled bar ,,	0·30 } ..	0·30
Ditto ,,	0·20 }	
Finished bar ,,	0·11	

The finished bar exhibited none of the cold-short quality ; it was exceedingly ductile ; indeed, excellent horse-shoes were made from it.

Another question, important to Heaton's process, is to know the exact proportion of phosphorus that wrought-iron and steel may safely contain without being injured in their physical properties ; and we are sorry to state that that proportion requires further investigation, although no research can ever lead to the determination of a definite amount, for the following reason :—Iron containing phosphorus, takes, upon cooling, a crystalline texture, and thus becomes brittle or cold-short ; but if forged immediately after heating, the crystalline texture and the cold-shortness will be lessened, and the more so the longer the iron is under the hammer.

Different investigators have recorded their opinions upon the influence of phosphorus upon wrought-iron and steel, thus :—

According to Karsten, there is little cause for apprehension respecting the quality of iron, as long as the phosphorus is below 0·5 per cent, and the only effect of a proportion of phosphorus up to 0·3 per cent is to make the iron harder without greatly diminishing its tenacity ; and Karsten considers iron, containing not more than the latter proportion of phosphorus, as belonging to the best and strongest quality. He states, furthermore, that iron containing 0·5 per cent still stands the breaking test, but not when containing 0·6 per cent ; this iron, however, can be bent at right angles, and struck over the anvil ; and that containing from 0·75 to 0·80 per cent shows decided cold-shortness. Iron containing 1 per cent is very brittle, and can only be applied to a few uses.

According to Eggertz, wrought-iron containing from 0·25 to 0·3 per cent of phosphorus shows some cold-shortness, but is fit for various fine forge purposes, such as the manufacture of nails, wire, &c.

Eggertz also states that most varieties of steel of high repute contain from 0·01 to 0·02 per cent of phosphorus.

Bauerman, in his treatise on "The Metallurgy of Iron," p. 29, states :—

"Wrought-iron containing not more than 0·3 per cent of phosphorus is not sensibly affected in tenacity, but is only rendered somewhat harder ; with 0·5 per cent it becomes somewhat cold-short, or incapable of being wrought cold under the hammer without breaking ; with 0·8 per cent, the cold-shortness is very decided, and 1 per cent makes the metal very brittle."

Concerning Bessemer steel, Bauerman states, on page 365 :—

"The best English pig-iron for use in the Bessemer process is that smelted from Cumberland hæmatite, about No. 1 or No. 2 in greyness. It should contain from 1½ to 2 per cent of silicon as a minimum, and not more than 0·2 per cent of phosphorus. At Essen, in Westphalia, the limiting quantities of foreign matters in the pig-iron preferred for Bessemer steel making, are, according to Jordan, as follows :—

Manganese	maximum ..	1·00	per cent.
Sulphur ..	,, ..	0·04	,,
Phosphorus	,, ..	0·06	,,
Carbon ..	minimum ..	5·00	,,
Silicon ..	,, ..	2·00	,,

Concerning the Bessemer process, it is stated in Ure's "Dictionary of Arts and Mines," vol. iii., 770 :—"As different samples were carefully analysed, it was ascertained that the red-shortness was always produced by sulphur, when present to the extent of 1-10th per cent, and that cold-shortness resulted from the presence of a like quantity of phosphorus."

It is greatly to be desired that Mr. Bessemer should publish his unquestionably rich experience of the influence of phosphorus and sulphur on steel.

We have already shown by analyses that the results of Heaton's process with regard to the elimination of foreign matters are similar to those of the puddling process. This, most probably, is the case, as the wrought-iron in both processes is produced in a pasty state, differing from the Bessemer process, which yields the wrought-iron in a liquid state.

Mr. Kirkaldy's experiments classify the one product of Heaton's process under wrought-iron, and the other under steel, as the former breaks at a burden of 23 tons per square inch and the latter at 43 tons, which is perfectly conformable with experience. However, we should like to have seen some further experiments on other qualities of the products of Heaton's process, such as property of welding, hardening, &c. And, though we consider the process open to improvement, it is, at all events, a step towards increasing the value of the inferior kinds of pig-iron ; and it promises great results. To promote such an object is, we think, but just and fair, and, accordingly, we have endeavoured, in the preceding review, to give an impartial examination of the present state of the Heaton process.

We propose to give in a subsequent article the detailed statements of the actual cost of making steel and wrought-iron by this process.

In conclusion, we may state that an impartial French commission, headed, with the sanction of the French government, by M. Gruner, *Inspecteur-Général des Mines* of France, and Professor of Metallurgy in the Imperial School of Mines, has witnessed the conversion of their own impure pig-iron into steel, and verified the cost of production. A report of that commission is expected shortly, which will doubtless assist in elucidating the precent obscure points in Heaton's process. We understand that M. Gruner has already reported that a sample of the slag was found to contain about 12 per cent of phosphoric acid—sufficient, indeed, to make it valuable as a source of that acid.

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Continued from p. 77.)

Unwholesome and Adulterated Food.

OCCASIONALLY we have examples of food which is of itself poisonous. This is so with many of the fish in tropical seas, and especially of the West Indies. Dr. Burrows has given us a long list of them; and it would seem that the yellow-billed sprat (the Sardine doré of the French, and *Clupea thryssa* of naturalists), the toad or bladder-fish (*Aplodactylus punctatus* or *Tetraodon* of Cuvier) and the grey-snapper (*Coracinus fuscus major*) are the most venomous; and that being eaten by larger fish, as the *Baracosta*, and various species of perch, as well as the conger-eel, the dolphin, the globe fish, &c., it causes these to be poisonous also. The yellow-billed sprat is so virulent in its action on the human body that both Europeans and negroes have been known to expire with the fish in their mouths unswallowed; and the toad or bladder-fish, is scarcely less dangerous. Sir John Richardson has described the effects of it on two sailors, the boatswain's mate and purser's steward, of the Dutch brig of war, *Postilion*, while lying at anchor in St. Simon's Bay, at the Cape of Good Hope, in September, 1845. The men were warned that the fish was poisonous, but believing that the liver was wholesome, and rather a delicacy, they cooked it, and ate it directly after their twelve o'clock dinner. In ten minutes the boatswain's mate was so ill that he could not stand; his face was flushed, his eyes glistened, his lips were swollen and rather blue, his forehead was covered with a cold perspiration, and his pulse was weak and fluttering. He was, however, quite conscious, and complained of pain and constriction of the throat, and he had a desire to vomit. In a few minutes more he became paralysed, his eyes were fixed, his breathing was laborious, his face was pale though his lips were livid, and in seventeen minutes he was dead. The other man exhibited the same symptoms, and died in twenty minutes. Sir John Richardson says the fish was not more than six or eight inches in length, and the liver of it, which they had eaten between them, could not have weighed more than half an ounce.

The symptoms occasioned by the poisonous fish of the tropics are always of two kinds—there is either great irritation of the stomach and bowels, like cholera; or there is rapid prostration of the vital powers, and death by syncope or convulsions. These effects have been long known both to natives and Europeans, and were called by the Spanish colonists of tropical America, *Siquatera*. They are more frequently observed at certain seasons of the year than at others, and hence they are thought to be due to certain physiological changes in the body of the fish, or to the food which it has eaten. In some cases the roe, in others the liver, or the digestive organs, are the most poisonous parts of the fish; and in the case of the *Maletta venenosa*, which inhabits the Caribbean Sea, it is only poisonous when the sea is covered with a green monad, upon which the creature feeds. Happily for us, these dangers are confined to the tropics, although we sometimes suffer from a milder form of disturbance, as irritation of the skin and bowels, from eating unwholesome shell-fish.

Putrid meat is, perhaps, wasteful rather than actually injurious; but there are plenty of cases in which it has caused disease. Foderè tells us that at the siege of Mantua, those who were shut in the city, and were obliged to eat the half-putrid flesh of horses, suffered from gangrene and scurvy; and in Czant's history of Greenland there is an account of the death of thirty-two persons at a missionary station called Kangek, from a repast on the putrid brains of a walrus. Similar cases are recorded in all the books on legal medicine. Even game, when only sufficiently tainted to please the palate of the epicure, has caused severe cholera in persons unaccustomed to it; but, as Dr. Christison observes, "the power of habit in reconciling the stomach to the digestion of decayed meat is inconceivable. Some epicures in civilised countries prefer a slight taint even in their beef and mutton; and there are tribes of savages still further advanced in the cultivation of this department of gastronomy, who eat with impunity rancid oil, putrid blubber, and stinking offal." The Zulus of Natal, according to Dr. Colenso, are so fond of putrid meat that they call it *ubomi*, which literally means to be superlatively happy. But, as a rule, there is a natural abhorrence of tainted food, insomuch, that with most persons, the mere commencement of decay is sufficient to excite disgust; and rarely do we find, except among savages, that an entire meal is made of putrid flesh. A little game or venison, or ripe cheese, at the end of a feast, with just a piquant touch of decay, is, perhaps, not objectionable; for it may, as Liebig supposes, promote digestion, by communicating its own quality of transformation to the rest of the food; but it is another thing to fill the stomach with putrid flesh, for if the corrective power of the gastric juice should fail, the effect of it might be serious. We have, indeed, abundant evidence of the terrible consequences of admitting putrid matter into the circulation, for they were once too common among those engaged in the dissection of the human body. In fact, the mere handling of decomposing animal matter for any time, will often produce disease of the hands or other parts of the body with which it comes into contact. Our safety, perhaps, in using such food is in the antiseptic power of good cooking; but this is not always an easy affair; for the tissues are generally so soft from decay that they will hardly bear the common action of heat; so that if they be boiled for any time they will fall to pieces; and if they be roasted, they will shrink without forming that delicious crust of osmazome which is characteristic of good meat. Let them, however, be cooked as they may, they always require a nice adjustment of rather strong flavours to make them palatable; and those who have dined in the cheap *restaurants* of Paris, or at the still worse table d'hôte of a German watering-place, will have experienced the art of the cook in this respect, in such dishes as *turbot en vol-au-vent*, *Raie au beurre noir*, *sole en matelote Normande*, and in the various forms of fish *au gratin*; or game *en salmis*.

But bad as this sort of tainted food is, it is nothing in comparison to the sausage poison, which is produced by a sort of modified putrefaction, to which the large sausages of Germany, and especially those of Würtemburg, are occasionally subject. According to an official return, there have been more than 400 cases of poisoning from these sausages in Würtemburg alone during the last fifty years, and of these about 150 were fatal. The effects are generally observed in spring, and mostly in April, when the sausages become musty, and acquire a soft consistence in the interior. They have also a peculiarly nauseous and rather putrid taste, and are very acid to test-paper. If eaten in this condition, they produce dangerous effects in from twelve to twenty-four hours—the first symptoms being pain in the stomach, with vomiting and diarrhœa, and dryness of the nose and mouth; then comes a feeling of profound depression, with coldness of the limbs, weakness and irregularity of the pulse, and frequent fainting. Fatal cases end with convulsions and oppressed breathing between the third and eighth day. The precise cause of these effects is still a mystery; some have thought that rancid fatty acids are produced during the decomposition of the meat; others that in the process of drying and smoking acrid pyrogenous acids have been developed; others that during the decay of the sausages, a poisonous organic alkaloid is generated. Liebig is of opinion that the effects are due to an animal ferment, which produces in the blood, by catalysis, a state of putridity analogous to its own, and that the molecular movements of the putrefactive change in the decaying meat are thus com-

* The Cantor Lectures, delivered before the Society of Arts.

municated to the living organism. M. Vanden Corput, who is one of the most recent investigators of the subjects, attributes the morbific action of such meat to the presence of a minute fungus, of the nature of a sarcina, which he calls *sarcina botulina*. This view is confirmed by the fact that there is always a peculiar mouldiness of the sausages; and the poisonous property is generally observed in April, when these cryptogamic organisms are most freely developed.

Similar effects have occasionally been produced by other kinds of animal food—as veal, bacon, ham, salt-beef, salt-fish, cheese, &c., and the food has usually been in a decayed and mouldy condition. It would be tedious if I were to detail, or even to enumerate the cases recorded by medico-legal writers; but I may, perhaps, refer to a few of them. In 1839, there was a popular fête at Zurich, and about 600 persons partook of a repast of cold roast veal and ham. In a few hours most of them were suffering from pain in the stomach, with vomiting and diarrhœa; and before a week had elapsed, nearly all of them were seriously ill in bed. They complained of shivering, giddiness, headache, and burning fever. In a few cases there was delirium; and when they terminated fatally, there was extreme prostration of the vital powers. Careful inquiry was instituted into the matter, and the only discoverable cause of the mischief was incipient putrefaction and slight mouldiness of the meat. Dr. Geiseler relates an instance where a family of eight persons were made ill by musty bacon; and M. Ollivier has given an account of six persons who were poisoned by mutton in a state of modified decay—four of whom died from it within eight days. In Russia, where it is the practice to eat largely of salt-fish in a raw condition, it is not at all uncommon to witness the dangerous effects of it when it has become mouldy or putrid; and, in fact, it is within the experience of every one who is concerned in medico-legal inquiries, that serious symptoms are frequently traced to the use of food in a modified condition of decay. This is especially so with bad cheese, the effects of which on the constitution have been so severe that official investigations have been called for. These effects have been noticed at Schwerin (1823), at Minden (1825), at Hameln (1826), at Griefswald (1827), Frankfort (1828), and elsewhere; and they have been the subjects of interesting essays by Henneman, Hünefeld, Westrumb, and others. At first the effects were attributed to the copper vessels used in the dairies, and therefore the Austrian, Würtemburg, and Ratesburg States prohibited the use of that metal for such purposes; but the subsequent inquiries of Hünefeld, Sertürner, and other chemists, established the fact that no metallic poison was discoverable in the cheese. In the police report, which was published in Frankfort, in January, 1828, informing the public of numerous cases of poisoning in that city from spoiled cheese, it was declared that no poisonous principle could be detected by chemical reagents. Professor Hünefeld and, subsequently, Sertürner, were of opinion that the effects were due to certain poisonous fatty acids analogous to, if not identical with, caseic and sebacic acids; and they even describe the way in which they are produced in the cheese during the process of ripening—attributing them to the imperfect removal of the acid liquor from the curd when the cheese was made, or to the putrefaction of the curd before it was salted, or to the mixture of flour with the curd; but it is far more likely that the poisonous effects are due, as Vanden Corput supposes, to the presence of a peculiar mould or fungus. I have myself seen the most terrible consequences from the use of such cheese, and have failed to discover anything unusual in the acidity or other chemical reactions of the cheese. Hünefeld says, it is commonly of a yellowish red colour, and is soft and tough, with harder and darker lumps interspersed throughout it, and it has a disagreeable taste, and an acid reaction. The symptoms which it produces are very much like those of sausage poisoning—namely, irritation of the stomach and bowels, with great prostration of the vital powers. These effects have been witnessed not only in Germany, where the cheese is generally rancid and bad, but also in this country, and particularly among the small hill-farms of Cheshire, where the limited extent of the dairies obliges the farmer to keep the curd for several days before a sufficient quantity of it is accumulated to make a large cheese.

I have said nothing of the improper practice of killing very young animals, especially calves, for food, before the tissues have had time to change from their uterine condition. On the Continent it is unlawful to kill or to sell calves for food that are not more than fourteen days old, but in this country there is no such restriction, and it is a common practice to dispose of the carcasses of newly-born or even fœtal calves to the sausage maker; and as the flesh is sodden and insipid, he strengthens it with old, tough, and sinewy flesh. It has the advantage, moreover, of being miscible with any description of meat, and of taking any variety of flavour; in fact, it makes just that kind of sausage which is susceptible of any kind of flavour, and where, to use the expression of Dickens, "It's the seasonin' as does it." I cannot say that such meat is positively unwholesome, but it is nasty, and excites the same sort of disgust as an egg with a chick in it.

(To be continued).

ON THE

CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,

(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE IV.

CARBONIC GAS, OR FIXED AIR.

Changes of charcoal itself, as distinguished from changes brought about by charcoal—Its little liability to change under ordinary circumstances—Its susceptibility to action of strong chemical agents—Change of charcoal into carbonic gas by its combustion or burning—Combustion of charcoal set up at very moderate temperatures—Its slow or rapid combustion in air according to circumstances—Its brilliant combustion in oxygen—Properties of resulting carbonic gas—Its usual production from chalk or marble—Its combination with lime to reproduce chalk—Its power of extinguishing flame—Its solubility in an equal measure of water—Its increase of solubility in water by increase of pressure—Effervescent waters made by saturating different waters with carbonic gas under pressure—Effervescence due to escape of excess of carbonic gas on removal of pressure—Residuary carbonic gas expelled on boiling the water—Solubility of chalk in water saturated with carbonic gas—Occurrence of so-dissolved chalk in most natural waters—Its deposition as boiler-

* Reported verbatim, by permission of the Author, for this Journal.

fur on boiling such waters—Carbonic gas, or fixed air, one and a half times as heavy as common atmospheric air—Various illustrations of its heaviness—Its capability of being poured through air, as a heavy liquid may be poured through a light one—Its outflow through a tap, transference through a syphon, baling out by a cup, &c.—Floating of air on carbonic gas, as of spirit on water—Gradual mixing of air with carbonic gas, and their non-separation after admixture.

You will remember that ordinary atmospheric air is a mixture of two different kinds formerly called vital and non-vital air,—or rather, instead of saying "non-vital," chemists used the word *azotic*, derived from the Greek. Vital air is now called *oxygen*, and the azotic is called *nitrogen*. When bodies burn in air they combine with the oxygen of the air, or, in other words, become oxidised, so that when you say a body is burnt in air, it is almost the same thing as saying that it is oxidised, for the fact of its being burnt implies that it becomes oxidised. Now, all the ordinary substances which we are in the habit of burning for the sake of getting either light or heat, consist substantially of carbon and hydrogen, though these do not form their exclusive constituents, as they frequently contain other elements as well. The carbon and hydrogen are in an unburnt or substantially unoxidised condition. This candle, for example, although is is perfectly white, contains a very large amount of carbon, and there is nothing more remarkable in the white candle containing carbon than there is in the white marble containing it. The only point of difference is, that in the marble the carbon is already oxidised or burnt, and in the candle it is not. When we light a candle we oxidise or burn its carbon, and we get its oxidised hydrogen in the form of water, and its oxidised carbon in the form of carbonic gas. When a candle is burnt with a sufficient amount of air, so as thoroughly to burn its constituents, we get nothing but these two products. Here is a bottle in which a candle has burned; the sides of the vessel are covered with moisture which has been formed in the burning, and on pouring some lime-water into the bottle, and shaking it up, it is converted into a mixture of chalk and water, by the carbonic gas which has been formed in the bottle by the combustion of the carbon of the candle. When, however, there is not enough air or oxygen to combine with both the carbon and the hydrogen of the burning candle, one of them must, in familiar language, "go to the wall," and it is the carbon which does so. The hydrogen is burnt first, the oxygen having a preference for it, and the candle deposits its carbon in the form of soot. Now, this is an illustration of the way in which nearly all the varieties of charcoal are made. The materials are burnt with an insufficient supply of air—enough to burn the hydrogen and not the carbon—and accordingly the carbon is deposited. Those large masses of coke which you see behind the locomotive engines are obtained in a similar manner. The coke consists of the carbon of the coal, the hydrogen being burnt away in the process of manufacture. In the same way, charcoal is got from wood by burning off the hydrogen and leaving the carbon unburnt; but there is altogether a different method by which the carbon may be separated from the hydrogen, and I mentioned it in my last lecture. Coal gas, you know, although perfectly transparent, contains black carbon, and when this coal gas is burnt with an insufficient supply of air we get soot by our old process (I call it *old* because of my having already spoken of it); but if, instead of burning the coal gas in that way, we make it very hot, under such circumstances that, through the exclusion of air, neither the carbon nor the hydrogen gets burnt, these constituents are separated from each other. Here is the tube containing the white porcelain, which, during the last lecture, we subjected to a strong heat while the coal gas was passing through it. The blackening of this white porcelain indicates that the carbon of the coal gas has been separated from the hydrogen, and the separation occurred, in this case, not from the effect of imperfect burning, but through the application of a strong heat. This, then, is another mode in which carbon may be obtained from its combinations. That large piece of carbon in front of you is called *gas carbon*, and it was made in the same way as that in the tube—by subjecting ordinary coal gas to a sufficiently high temperature. That carbon ought to have remained in the coal gas, but it was separated from it, and lined the interior of the vessel when the hydrogen passed on and left it.

Having spoken of the different ways in which carbon may be separated, I will just call your attention to an experiment which shows the actual production of it. I have here a small platinum dish, in which I have placed some substances capable of being burnt; these are nothing but nuts, kernels of fruit, acorns, and so on. If I simply burn them, they will all go away, and nothing will be left of them; but if, before making them hot in the dish, I take the precaution to cover them with sand, so that they get a very small supply of air, then they will burn imperfectly, and at the end of the lecture we shall have a residue in the form of charcoal. I am applying a good strong heat, and, in a little while, the hydrogen gas will escape from the top of the sand, and there ignite. You will see the hydrogen and a portion of the carbon burning, but the great mass of the carbon will remain behind, and we shall find it at the close of the lecture much in the same form as you see these nuts and kernels in this glass, converted into

charcoal. [Later in the lecture the hydrogen driven off by the heat from the contents of the platinum dish was observed to be burning on the surface of the sand].

So much for the way in which carbon is obtained; now for its properties. You will recollect that in the last lecture I called your attention to its very remarkable effects in absorbing gas. When you take a piece of charcoal into your hand, you not only have the carbon there, but you have also a large quantity of air or gas condensed in the pores of that carbon. In our last lecture, by means of an experiment with the air-pump, I showed you the charcoal giving up the air which had been contained in its pores. That was an illustration of the mode of extracting the air from the charcoal. Now I want to shew you the way in which we can get air *into* the charcoal. In this case, the air we will take is ammonia. I performed the experiment during the last lecture, and I will now repeat it. You see that the charcoal is gradually absorbing the ammonia gas, and, as it does so, the mercury rapidly rises.

There are some other curious properties of this charcoal to which I briefly alluded in my last lecture, and about which I wish now to make some further remarks. You will recollect my telling you that the gases given off by the partridge, undergoing the change called putrefaction, are absorbed into the charcoal, but they are something more than absorbed—they are *destroyed*. They are slowly burnt or oxidised—for you will remember that burning is another word for oxidation. The charcoal absorbs not only the gases given off by the partridge, but also these atmospheric gases, and when these come into contact with the gases given off by the partridge, which are, particularly, sulphuretted hydrogen and ammonia, they destroy them by oxidation. Now, this sulphuretted hydrogen gas which is emitted by putrefaction, has an exceedingly objectionable smell, and this smell affords one of the most delicate means of recognising its presence; but, fortunately, there are other ways of detecting it. It has the property of affecting certain metals, and when we want to ascertain whether this gas is present, we are not obliged to resort to the unpleasant method of smelling it. In this glass jar I have some paper which has been prepared with a metallic solution, and I will cause a current of sulphuretted hydrogen gas to pass through the tube into the jar or cylinder, and you will notice, I think, in the course of a little while, that our test paper inside the cylinder, indicates to us the presence of the gas, just as effectively as its smell would do, if we put our noses to the vessel. You see that the letters gradually come out on the test paper; they have now become perfectly visible. Thus we are able to recognise this gas, not only by its smell, but by its action on the paper. I have here a tube which brings me a current of ordinary air, worked from a bellows below. This current bubbles up through a solution containing sulphuretted hydrogen, and, in so doing, it takes some of the sulphuretted hydrogen with it; it then goes into this glass vessel, when the sulphuretted hydrogen affects our test paper, and the air escapes from the top of the jar. If it escaped direct into the theatre, the sulphuretted hydrogen would be smelt by you; but I place over the top of the jar some pieces of wood charcoal, which absorb the sulphuretted hydrogen, and destroy its smell. We will now try the action of this gas on another kind of test paper, and here the effects will be somewhat similar to those produced in the last experiment, only, in this case, I have no letters written upon the paper. We will pass the gas through this other cylinder containing test paper, and you will see what effect it has there. In this case, the paper, instead of being written over with letters formed by a test solution, has been steeped in different solutions, and accordingly a very much larger quantity of gas is necessary to colour the whole of the surface. You see the paper is now becoming coloured; first we have the action of the gas upon a salt of lead, as shown by the production of a black mark. As the gas rises higher and higher, you see it begins to effect the next solution on the paper, and in this case, instead of a black stain, we get an orange one, and I daresay, after a little while, another colour will be developed at the top. I may call your attention to the bottom of the paper becoming yellow. The colour at the top is now appearing, and at the risk even of getting a slight smell from unabsorbed sulphuretted hydrogen, we will allow the action to go on to the full extent.

I want now to illustrate to you the mode in which charcoal arrests the flow of this gas, and for this purpose I will here take some small glass cylinders, containing metallic solutions upon which sulphuretted hydrogen will act, and I am going to blow through these solutions the same kind of sulphuretted air that I blew into these larger cylinders a few minutes ago; but I will arrange the experiment in such a way that before the air bubbles up into the water, I can either let it pass through the charcoal or not, at will. I am afraid that in this case I cannot keep back the odour, but I will endeavour to do so as much as I can. Here is one pair of cylinders, and the gas which passes through them must, first of all, go through the charcoal; but in order to pass through the other pair of cylinders it need not do so. We will first of all let it go through these cylinders where there is no charcoal, and then see what are its effects. The gas now enters our solutions, and im-

mediately produces, in the one case, a purple colouration, and, in the other, a decided orange. This is caused by the gas itself, before it has gone through the charcoal. Now we will let it come up from the other cylinders; in this case, it has first of all to go through the charcoal. Now you see that after it has gone through the charcoal it has no action whatever upon the solutions. It is now bubbling up through these solutions in the same way as it did through the others, but here we get no action. The charcoal completely arrests the passage of the gas—not only arrests it in the way of absorbing it, but entirely destroys it. In this instance, we are passing the two gases, sulphuretted hydrogen and oxygen, into the charcoal, and these immediately react upon one another in the pores of the charcoal. In order to show you that the want of effect does not arise from any exhaustion of our sulphuretted material, we will now let it ascend through these new vessels, without passing through the charcoal, and you see that the solution on my left very quickly becomes orange in colour, and that on my right becomes purple. Thus, the want of action was not due to a deficient supply of sulphuretted gas, but it was merely owing to the fact that, as the gas passed through this tube containing charcoal, it was so completely absorbed and oxidised that it could not, in any way, affect the solution through which it afterwards bubbled.

With regard to the action of charcoal upon liquids, you will remember that, on the last occasion, we had two long columns through which we filtered a red and a blue liquid, both of which had their colours completely taken out. I ought to call your attention to some of the practical applications of this property of charcoal. Here are some specimens of Madeira, Demarara, and beet-root sugar, which have been kindly supplied to me by Mr. Duncan, of Whitechapel. The whole of the colour of these liquids has been taken out by filtering them through charcoal, in the way that you saw me filter the liquids the other day. After the first filtration, you get a liquid which has a distinctly brown tinge when compared with the white sugar, but after a second filtration through charcoal the liquid, on evaporation, yields pure white sugar.

Now, in all those changes to which I have called your attention, the charcoal itself remains the same. We have next to consider more distinctly the changes which charcoal undergoes, apart from those which it is capable of producing upon other bodies.

Charcoal is a very stable body. It lasts for ages and ages, and is not liable to decay. In the British Museum there are specimens of charcoal which were charred at Pompeii, and which have stood for centuries. It is one of the most stable bodies we know; nevertheless, it is capable of being acted upon by strong chemical re-agents. I will take some of this substance, and act upon it by an acid. I must have my charcoal rather warm for this purpose, and now I let it fall into this strong chemical agent—nitric acid—and you see that, under these circumstances, the nitric acid acts upon the charcoal very violently. The charcoal, which is a very permanent body, and not affected by most chemical agents at ordinary temperatures, is acted upon by this nitric acid, and to such an extent that it not unfrequently takes fire, as in this experiment.

The most important, however, of the changes which it is capable of undergoing, is one to which I have already, on one or two occasions, directed your attention, namely, its change into carbonic gas, and now I am going once more to show you this change, but in a somewhat different form. I have here a piece of easily igniting charcoal enclosed in this tube; I just set fire to it at one end, and place it alight in the tube, through which I pass a current of oxygen gas. You observe that the charcoal is now burning with very great brilliancy in the oxygen gas. The charcoal is converted into a gas, and as it bubbles up through our lime-water it changes the lime-water into a mixture of chalk and water. In this way I cause the complete disappearance of the charcoal, it being converted entirely into the carbonic gas, which I am arresting by means of the lime-water. Here you see the large amount of chalk which I have produced by the conversion of our charcoal into carbonic gas, and the combination of that carbonic gas with the lime contained in the lime-water.

Now I will illustrate the conversion of charcoal into carbonic gas in one or two other ways. I will bring before you another mode by which we may burn this substance in oxygen. You observe I am burning some in a globe full of this gas, and it is ceasing to be charcoal, and is being changed into carbonic gas; and here you have an illustration of the most remarkable, or, at any rate, the most important of the changes which charcoal is capable of undergoing. Lastly, I will show you one more experiment illustrating the mode in which we can burn charcoal in oxygen. [A stream of oxygen was made to impinge upon some pieces of incandescent charcoal lying at the bottom of a glass beaker]. You see the very brilliant manner in which the charcoal burns in our current of oxygen gas.

We have, then, arrived at this point—that charcoal is a substance which burns very readily, and, by its combustion, is converted into carbonic gas.

(To be continued).

CORRESPONDENCE.

ON PHOSPHORUS IN IRON AND STEEL.

To the Editor of the Chemical News.

Sir,—In the Chemical News of January 29th, page 58, is an abstract of a paper by Dr. B. H. Paul, read at the Chemical Society, on "The Connection between the Mechanical Properties of Malleable Iron and Steel, and the Amount of Phosphorus they contain," and a report of the discussion which followed it. Judging from these, it appears that the very serious fallacy upon which Dr. Paul's conclusions were based was not detected by any of the distinguished chemists who were present and took part in the discussion.

The fallacy I refer to is that of judging of the quality of steel by Mr. Kirkaldy's tests of tensile strain, &c. Had Dr. Paul carried his researches further by examining in the same manner the relative tenacity of several samples of iron (or of steel containing but little carbon), which varied only in the quantity of phosphorus they contained, he would, probably, come to a much stronger conclusion, and have asserted, as some continental chemists have done, that phosphorus, up to 0·50 per cent, improves the quality of steel. The action of phosphorus on iron and steel is to increase their hardness and their brittleness when cold, and at the same time—within certain limits—it increases their tenacity, provided they are not already highly charged with other hardening constituents. I refer here only to the tenacity as measured by a *direct and gradually applied longitudinal or axial strain.*

If the iron or steel were required for tie rods, to be subject only to a strictly axial pull, that should never occur suddenly, and that should be quite unaccompanied by vibrations, Dr. Paul's conclusion that 0·24 per cent of phosphorus would be quite a harmless quantity, and Dr. Miller's statement that 0·298 per cent of phosphorus in steel iron "is obviously not such as to injure the quality" would be quite correct, for steel iron for such a purpose would be improved by that amount of phosphorus. It is, however, quite obvious that such a combination of conditions is practically impossible.

When we consider the work to be done by the edge of a chisel, a hatchet, a sword, a graver, or a turning tool, by the teeth of a file, or a saw, or the duty of edged tools generally, it is obvious that the power of resisting a sudden, a vibratory, and a transverse shock is the property most demanded. Now this is just the property which phosphorus tends to destroy. An excess of combined carbon has a similar effect, and it is impossible to obtain hardness without a sacrifice of toughness, but this sacrifice is much greater when hardening is obtained by phosphorus than when it is conferred in an equal degree by carbon.

I have never tried the experiment, but have very little doubt that a factitious steel might be made in which phosphorus should replace (in a lower proportion) the carbon of ordinary steel, and that such a factitious steel would take a very respectable position if tried by Mr. Kirkaldy's direct tensile test *only*. It would, however, be practically useless on account of its incurable brittleness. This brittleness would be indicated by Mr. Kirkaldy's *extension test*, but not to its full practical value on account of the gradual application of the strain and the absence of vibration.

Phosphorus has another prejudicial effect upon steel, which is not in the slightest degree indicated by either the tenacity or the extension tests. I refer to the intractability of the hardness which it confers. The hardness which carbon gives to steel possesses the characteristic and invaluable susceptibility of annealing and tempering; it may, within certain limits, be modified through an infinite series of gradations, and the steel thereby may be worked by steel, and adapted to the multifarious uses for which it is required. The hardness conferred by phosphorus is practically a constant quantity at a given temperature. It disappears when the iron or steel is heated, and returns on cooling; but, as far as I have at present been able to learn, the rate of cooling does not sensibly modify it.

I make the above remarks with all due deference to Dr. Miller and the other eminent chemists whose opinions on this subject I have ventured to controvert, but, as my daily work is amidst the volcanic belchings of Bessemer converters, the thumping, crashing, and earthquaking of steam-hammers, &c., I have opportunities of comparing the results of chemical analysis with the verdicts of practical trials, which are quite unattainable in any college laboratory. With all these advantages, I find the solution of such questions as the action of small quantities of phosphorus so very difficult, that I make the above remarks with some diffidence as a crude exposition of approximate knowledge.

As regards the Heaton process, which has led to this discussion, I may state that I have visited Langley Mill, and examined the work done there, on behalf of the company by whom I am employed, and although it is not my intention to here express any opinion as to the general merits or demerits of the process, I cannot refrain from saying that it appears to me that Mr. Heaton is somewhat misled on this particular subject of phosphorus—that he is not doing justice to himself in making his early trials chiefly with inferior pigs containing excessive quantities of phosphorus. Had he directed his first efforts to the production of the best quality of steel from the best quality of pigs, rather than endeavouring to compete with the Bessemer process in the race of cheapness, I believe that his results would have been more satisfactory and conclusive.

The difference in value between the best and the worst qualities of British pig-iron is about £3 per ton, while the difference in value between the best qualities of cast-steel and an ordinary Bessemer steel rail, is quite ten times that amount; and I suspect that the conversion of the best pigs to steel of a given hardness would be effected with a smaller quantity of nitrate than is required for those of inferior quality. The worst sample of Heaton steel that I have analysed contains 0·24 per cent of phosphorus, the best only 0·05 per cent. They differ widely in other respects. The first sample I saw made from an inferior pig-iron from the neighbourhood of Mr. Heaton's works, and which I had already analysed; the second was, I believe, made from a pig of very superior quality to this. The difference in value between the two products is many times greater than that between the raw materials.

Since writing the above I have received the current number of the Chemical News, and there read an extract from *Engineering* on this subject. You wisely disclaim any endorsement of the views there expressed. I had no intention of expressing in this letter any general opinion on the merits of Mr. Heaton's process, but this extract contains two statements which are so outrageous, that I cannot, as a lover of truth, abstain from flatly contradicting them. The first is that "*The Heaton process never produced an ounce of steel or anything resembling it.*" I have examined six samples of the product which I saw made from a pig-iron I had already analysed. The analyses of all these samples proved them to be steel, and the comparison between their composition and that of the pig-iron proved that the process was one of true conversion.

The next statement referred to is that "the furnace in which Mr. Heaton professes to melt steel at a cost for coal of 5s. per ton was never built." I was at Langley Mill on the 13th of January last, and there saw and carefully examined the furnace referred to. It was a furnace that had seen some service as proved by the vitrified surface of the flues and fettling. I speak only of the *existence* of the furnace, not of its action, as I have not seen it in operation.

I am glad to see that this subject is to be taken up in the pages of the CHEMICAL NEWS which have never been used for the purposes of trading puffs or trade animosities, or that editorial pandering to advertisers in which some of the so-called scientific publications of the day have so largely indulged.

This nitrate of soda process involves some obscure chemical reactions of great scientific interest, irrespective of its commercial objects, and a description of the chemical questions it opens, in a journal which has uniformly been devoted to the faithful service of science, cannot fail to be of considerable value.—I am, &c.,

W. MATTIEU WILLIAMS.

The Laboratory, Sir John Brown and Co., Sheffield,
February 13, 1869.

DR. WALLACE'S LECTURE ON THE CHEMISTRY OF SUGAR REFINING.

To the Editor of the Chemical News.

SIR,—The absence of Dr. Wallace when the above lecture was read is much to be regretted. No doubt many were present who, like myself, would have been glad to have asked some questions of the author, and I think it a pity that, under the circumstances, the lecture was not postponed.

Dr. Wallace, in his remarks upon the bleaching action of ozone upon sugar, expresses a fear that this powerful agent will be found to destroy too much of the sugar to permit of its successful use. I am anxious if possible to allay this fear by stating that my researches upon this subject have convinced me that ozone, although it acts powerfully upon caramel, has, in the way in which I apply it, no action at all upon sugar. I found in one experiment that the juice of beet-roots grown in London, which marked only 6° Baumé, was perfectly crystallised when kept at a temperature of 160° F. and submitted at this temperature to the action of a current of ozonised air. Anyone conversant with the difficulty of effecting the crystallisation of weak cane or beet juice, especially when operating on small quantities, will perceive that in this case the sugar would not have crystallised if it had been injuriously affected by the ozone.

As I remarked in the course of the discussion on Dr. Wallace's lecture, I do not think the ozone process is as yet sufficiently advanced to justify me in speaking with certainty upon it, but the few statements which I have made in regard to it are founded on careful experiments, and may be relied upon. In the meantime I cannot help remarking that none but those who have themselves experimented upon the process, can form any satisfactory opinion upon it, or have any right to comment on its merits or demerits.—I am, &c.,

EDWARD BEANES.

Cordwalles, Maidenhead, Berks,
Feb. 17, 1869.

MISCELLANEOUS.

Glasgow Philosophical Society (Chemical Section).—A meeting was held in the Society's rooms, Andersonian Buildings, on Monday evening, the 15th inst., at eight o'clock, E. C. C. Stanford, Esq., in the chair. One new member was admitted, and one candidate proposed. Mr. Gavin Chapman read a paper "On the Best Method of Utilising Sewage," which we hope to be able to give fully in an early issue.

A Curious Vocation for a Scientific Society.—Amongst the objects for which The Victoria Institute or Philosophical Society of Great Britain has been formed is, "to give greater force and influence to proofs and arguments which might be regarded as comparatively weak and valueless, or be little known if put forward merely by individuals."

The Heaton Steel and Iron Process.—In our last number we gave a very short abstract of an article in *Engineering*. The assertions therein made appeared so bold and expressed in such strong language, that we took the precaution of prefacing our abstract in such a manner as not to mislead the readers of this paper into supposing that they received our sanction. Last week's *Engineer* contains a long letter from Mr. John Heaton, in which he refutes in the most positive manner the various statements concerning the Heaton process which have from time to time appeared in *Engineering*, and we have since been informed that two actions have been commenced against the editor of *Engineering*, so as to bring the whole matter before a legal tribunal.

Abstract of the Petroleum Acts of 1862 and 1868.—(1). The object of these acts is the better protection of life and property from fire. (2). The acts only relate, (*a*) to oils or spirits obtained from the mineral kingdom, indeed (*b*) only to such of these liquids as, at any temperature below 100° F., give off inflammable vapour sufficiently fast to afford a distinct flash of flame on the approach of a light. (3). The mineral oils or spirits which thus enkindle below 100° may only be sold (wholesale or retail) when the containing vessel bears the following label:—"Great care must be taken in bringing any light near to the contents of this vessel, as they give off an inflammable vapour at a temperature of less than 100° of Fahrenheit's thermometer." (4). Dealers in these labelled liquids may, without restriction, store them in any place that is more than fifty yards from a dwelling-house or warehouse. Before they may be kept *within* that distance either in large or small quantities (except for private use) the dealer must obtain a licence from one of the following authorities:—The Court or Council of a Mayor and Aldermen; the Metropolitan Board of Works; Local Improvement Commissioners. (In Scotland) any Town Council or Police Commissioners. (In any harbour) the harbour authority. (In other places in England) the Justices of Petty Sessions. (In other places in Scotland) any two Justices of the Peace for the County. (5). Inspectors of Weights and Measures are empowered to inspect stocks. Offenders under the act are liable to be fined.

NOTES AND QUERIES.

Bavarian Beer.—Liebig states that 1460 quarts of best Bavarian beer contain exactly the nourishment of a two-and-a-half pound loaf of bread.

Oreïde.—Composition of the alloy termed "oreïde":—Copper, 79·7 parts; zinc, 83·05; nickel, 6·09; iron, 0·28; tin, 0·09. This alloy, the two last constituents of which are purely accidental, resembles gold, and is used at Paris for imitating jewellery. A white alloy, very much resembling silver, consists of 69·8 parts of copper, 19·8 of nickel, 5·5 of zinc, and 4·7 of cadmium; it is a very hard alloy, which takes a beautiful polish.

MEETINGS FOR THE WEEK.

MONDAY, 22nd.—Medical, 8.
—— London Institution, 6.
TUESDAY, 23rd.—Royal Institution, 3. Rev. F. W. Farrar, "On Comparative Philology."
WEDNESDAY, 24th.—Geological, 8.
—— Society of Arts, 8.
THURSDAY, 25th.—Royal Institution, 3. Dr. Harley, "On Respiration."
—— London Institution, 6.
—— Royal, 8.30.
—— Zoological, 8.30.
FRIDAY, 26th.—Royal Institution, 8. Dr. Bridges, "On Civilisation and Health."
—— Quekett Club, 8.
SATURDAY, 27th.—Royal Institution, 3. Dr. Odling, F.R.S., "On Hydrogen and its Analogues."

*** Owing to press of matter, our answers to correspondents are unavoidably postponed till next week.

THE CHEMICAL NEWS.

Vol. XIX. No. 482.

ON THE ACTION OF CARBOLIC ACID AS A THERAPEUTIC AGENT.*

By JOSEPH HIRSCH, Ph.D.

The interest and importance of carbolic acid at the present day as a therapeutic agent were too tempting an invitation to experiment somewhat with this substance to be resisted, and although the experiments were so simple as to be hardly noteworthy, they still serve so far to illustrate the *modus operandi* of the acid, that I venture to recommend its trial in the treatment of some diseases in which, until now, the so-called expectative treatment, *i.e.*, no treatment at all, except good nourishment, has been pursued as the only useful one. The starting point of these experiments was the power of the acid to coagulate albumen, which it does in virtue of its nature as an acid by entering into a union with the albumen. Reflecting upon the therapeutic action of carbolic acid, one is naturally led to connect it with its influence upon albumen, because this reaction is a very marked one, while albumen plays the prime part in the animal organism, being present in all those substances which supply the entire body or individual parts of it with the materials requisite for nutrition and the renovation of effete matters. It is the main constituent of the blood, the lymph, the chyle, and all serous fluids contained in the cellular tissue—in fact, all animal tissues are surrounded by an albuminous fluid, and all changes in the blood proceed from the albumen. For the purpose of my experiments I therefore took three series of solutions of albumen. The one was chemically pure albumen, prepared from white of egg in the well-known manner; the second was white of egg in its natural state and also diluted to nearly one-half, *i.e.*, the concentration in which it occurs in the blood; the third series were solutions of blood albumen, or serum, taken from cattle, sheep, and the pig, deprived as nearly as possible from the red corpuscles, so as to show the influence of the salts contained in the blood upon the behaviour of the albumen towards carbolic acid.

At the same time I prepared solutions of carbolic acid of different strength, with which to test the manner and extent of coagulation of the albumen. I dissolved the acid in glycerine, starting with solutions of 90 per cent of acid, each subsequent solution containing 10 per cent less of the acid, while I carried the fractions of 1 per cent down to 0·01 per cent, having nine solutions containing less than 1 per cent of carbolic acid, and eleven solutions containing 1 per cent and over.

The series of solutions of pure albumen were more or less congealed during these experiments, even before they were coagulated by the acid. The coagula were less firm than those of the other solutions produced by acid of the same strength, of which even the most concentrated penetrated the entire mass of albumen much quicker than any of the other albuminous solutions.

The blood albumen also coagulated slightly faster than that of egg, but less so than the first mentioned series. Here the salts then seemed to act as diluents, rendering the coagulum more porous. This difference in the time of coagulation of the various solutions of the same strength was the main difference observable. In those of different concentration it appeared, in addition, that in the more diluted solutions the coagulum grew in streaks downward, while in the concentrated solutions it progressed evenly over the entire surface of the albumen. In this case the solidification proceeded exceedingly slow.

The coagula produced by the most concentrated solutions were the most solid, but the least voluminous. The acid was added slowly to prevent a disturbance of the solutions of albumen, upon which the former floated, extending thus its action gradually downward. This took place very slowly with the dense solutions, the coagula of which appeared to be almost impenetrable to the acid, causing the substratum of liquid albumen to remain unchanged for a great length of time. The more diluted solutions produced a softer coagulum, easier penetrated by the excess of carbolic acid, while with the greatest dilutions the albumen coagulated in fibres, until finally only a turbidity was the result of the mixture.

The fibrous coagula were washed upon a filter with remarkable facility, while the coagula produced by greater dilutions partly passed through the filter, which, though finally, was clogged. These clogged filters I fastened to one end of glass tubes perfectly tight, of which I assured myself by keeping the tube filled partly with water for twenty-four hours. Testing, then, this primitive endosmotic apparatus with a solution of sodic chloride alongside of another one of the same size, constructed with bladder, I found the albumen apparatus to work somewhat faster than the other; but in consideration of the fact that the paper filter could not be drawn as tightly over the opening of the tube as the bladder for fear of tearing it, the quicker permeation of the filter may be ascribed to its greater surface. All the coagula placed under water at a temperature of about 80° F., for over three months remained apparently unchanged, although some of them during all this time were mixed with either one of the following substances, in which putrefaction had set in before their addition to the coagula. These substances were casein, blood, brewers' yeast, and leaven. There seems, then, to have remained a sufficient quantity of carbolic acid within the pores of the coagulated albumen to arrest even the decomposition of the substances added.

With these preliminary experiments, I compared the effect of carbolic acid upon the system; the application of a concentrated solution of the acid to the skin produced, in a short time, a white opaque spot of horny aspect, which soon peeled off. The same spot produced on a highly sensitive part of the epidermis, as on the tongue, at once loses its sensitiveness; and a feeling as of the presence of a foreign body as coating is experienced.

In both cases the opacity of the spot, by its resemblance to the opaque coagulated albumen, at once reveals the nature of the change produced by the acid. "The albumen of the blood, which through the numberless ramifications of the blood-vessels is carried to the skin for its nourishment, becomes coagulated." In this state it is solid, precluding the motion of liquids of its own kind within its substance, and with this motion nourishment and life. As lifeless, dead matter, the skin must necessarily peel off; it must, with the loss of vitality, be deprived of all the prerogatives of life, of feeling, as noticed above. Taking the coagulation of albumen as the immediate effect of applying carbolic acid to any organic substance, we shall find no difficulty in explaining the suspension of life without its complete extinction in the microscopical beings known as contagion. They contain, no matter whether they are animalculæ or minute plants—a question not yet definitely settled—albumen; blood albumen in the former case, vegetable albumen in the second.

Here the carbolic acid, coagulating the albumen on the surface of the corpuscle, forms an insoluble envelope, impenetrable to air and to further quantities of carbolic acid, which in this manner forms an obstable to the entrance of greater quantities of itself into the interior of the small body. This then retains in its centre a minute portion unchanged, full of life, capable of increase under favourable circumstances, and protected from external

* Communicated by the Author, having been read before the Chicago College of Pharmacy.

influences by its coating of coagulated albumen. Such a corpuscle acted upon by carbolic acid may be represented by an egg exposed to boiling water for a few seconds. The coagulating influence of heat affects the superficial layer of albumen, which still encloses the rest of the egg in its raw state. All substances or processes producing the same coagulating effect upon albumen do in reality exert the same destructive influence upon contagion and miasma, but none possess other necessary properties qualifying them for this purpose as well as carbolic acid. Heat, which coagulates albumen, has been used successfully in the disinfection of places and clothing infested with the poison of cholera, small-pox, yellow fever, &c.; but while we can turn high pressure or even superheated steam into a room, a ship, &c., we cannot subject a cholera patient, or an animal infected with the cattle plague, to so high a temperature as to destroy the poison lurking within them; and if in diluted carbolic acid we have a remedy, which with such coagulation will destroy the activity of contagion without interfering with the process of life in the patient, we have found a desideratum which is at once a boon to mankind and a victory of science important beyond comparison. Other chemicals, as the mineral acids, their salts which coagulate albumen, also destroy contagion; but their destructive influence upon the animal organism in that state of concentration in which they coagulate albumen precludes their use in contagious diseases under the same circumstances, for similar reasons, under which superheated steam is unavailable.

On the other hand, carbolic acid in great dilution exerts a barely perceptible influence upon the vital process of the larger animals, while its power of destroying sporules is almost equal to that of the concentrated acid.

This apparent anomaly is easily explained on comparing its action to the parallel coagulation of a highly diluted solution of albumen by one similarly diluted of the acid. The diluted solution is as completely coagulated as a dense one; but the immense dilution places the particles of albumen at such great distances from each other that they can no more form a coherent mass after coagulation, but remain separately suspended in the liquid, rendering it opaque and milky in appearance. This liquid, although charged with insoluble albumen, will filter through paper, as also through the pores of all the tissues of the animal organism. The dilute carbolic acid introduced into the system will, in the same manner, coagulate the albumen and sporules it meets upon its passage in such subdivision that the coagulum can no longer form a dense coherent coating, as is the case during the application of the concentrated acid, while the minute particles of this coagulum, after filtering through the animal tissue, do no longer oppose an obstacle to the free passage of greater quantities of the carbolic acid or of the vital fluids.

On the other hand, the sporules, constituting the contagion, are so minute themselves that the limited sphere of action of the diluted acid still embraces a complete sporule, or a number of them, which thus have their vitality suspended as completely as by the concentrated acid.

The great divisibility, respective volatility of the acid, prevents its complete neutralisation by the albumen of the larger organism to the exclusion of that of the sporules, the albumen being a base of no great energy, especially if linked to as faint an acid as carbolic. Nevertheless for a complete curative effect the dose must be repeated, as the acid owns, in common with all other drugs, the property that the limit of its sphere of action is proportionate to its amount. The manner of action of the acid as shown illustrates the difference of its operation as a disinfectant from other substances used for that purpose, which are mostly oxidising agents acting upon the products of decomposition, like ammonia, hydric sulphide, &c., which are altogether out of the sphere of action of carbolic acid, because they are not capable of coagulation. They may partly be neutralised by the same, but being volatile, it is not superior in this respect to the ordinary mineral acids.

The great reducing powers of carbolic acid recommend it for the detection of hydric peroxide, as has been proposed lately. The addition of the last-named substance to a mixture of aqueous carbolic acid and ferrous sulphate produces a permanent green colouration. Here the carbolic acid prevents the oxidation of the ferric protoxide by the hydric peroxide, which, without its presence, takes place.

That this reducing action is a prominent factor in its mode of destroying contagion, by preventing oxidation, which is synonymous with life, there is but little doubt. For the kindred processes, like fermentation, have been found to be true processes of oxidation, and we are enabled to prevent or stop fermentation by various other reducing agents—for instance, the hyposulphites, the efficacy of which in various contagious diseases has also been well tested.

ON THE

CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(Adapted to a Juvenile Auditory),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,

(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE IV.

Carbonic Gas, or Fixed Air.

(Continued from p. 94.)

Having considered the properties of charcoal somewhat minutely, I will next examine more particularly a substance to which I have already made very frequent reference, namely, carbonic gas, which is the product of the burning or oxidation of charcoal. What, then, are the properties of this carbonic gas?

First of all, with regard to the mode in which it is made. You will remember I made it just now by burning charcoal. That is one way; but another way is by starting, not from charcoal, but from marble. If we take some marble and heat it very strongly, it gives off this carbonic gas; but instead of acting upon it by heat we more commonly, as a matter of convenience, treat it with acids, and consequently we employ an apparatus of the kind which you have seen used for that purpose at previous lectures. Here I have such an apparatus, in which carbonic gas is being produced from marble, and from which I can obtain it in order to consider its properties minutely and *seriatim*. I first turn on our gas, and immediately we re-

* Reported verbatim, by permission of the Author, for this Journal.

cognise one of its characters, namely, that it has the property of combining with soluble lime, and of converting it into insoluble chalk. The next property of the gas which I shall show you is also one to which I have before alluded—its property of extinguishing flame. Here is a large glass jar which has been filled with carbonic gas from an apparatus beneath this theatre, similar to the one on the table, but which is on a larger scale, and supplies us more conveniently with the gas. We will see whether this glass jar is full of the gas. [A lighted taper was extinguished immediately upon being introduced within the brim of the jar.] Yes, it is quite filled. You see, directly I put the taper in it is extinguished. If I take some larger substance than this—this burning tow, for instance—it also is completely extinguished. The second property of carbonic gas, then, is that of putting out flame.

I wish now to make you acquainted with some further properties of this gas, so I will first show you what its behaviour is under certain circumstances, and then I can remark upon it after you have seen the experiments. Here is a long tube filled with water, and having its open end immersed in the same fluid. I will raise the mouth of the tube a little, and fill it to the label with carbonic gas; I take the tube and shake it up with the water, and then notice whether any effect is observable. I keep it closed firmly with my hand, and replace the mouth in water; on removing my hand you see that the liquid rises very considerably in the tube. This experiment, then, reveals to us the fact that carbonic gas is capable of being absorbed in water. It dissolves appreciably in water through this agitation, but it will dissolve to a much greater extent under pressure. The experiment is rather too long to allow me to show it to you as a lecture experiment, but I will point out to you its result. If I took a bottle of ordinary water, and applied this forcing syringe to it, I could inject into that water a large quantity of carbonic gas—a quantity, indeed, only limited by the strength of the bottle. I could go on forcing in the gas until I burst the bottle. Here is a bottle of soda-water which I have made by pumping carbonic gas into ordinary water, and, in fact, most of the soda-water ordinarily met with is made in this way. On removing the pressure from the surface of the liquid, the gas escapes, and this gas which is given off is nothing more than that which is obtained from marble or burning charcoal, and it has all the properties which I have mentioned as belonging to carbonic gas. You will remember that the gas from marble has the property of extinguishing flame and of making lime-water turbid. I will collect some of the gas evolved from soda-water, and I will then show you its properties. Here, for example, is a bottle of soda-water; I open it in the usual way, but cautiously, so that the gas may not escape very violently. Having removed the cork, I let the gas from the soda-water play upon the flame of a candle, and you see it at once puts it out. Now let me show you the amount of gas which we can collect from a bottle of soda-water. I take a cylinder of water, close it with a glass plate, and invert in a pneumatic trough. Here is a bottle of soda-water, into which I have inserted a tap; this I turn on, and allow the escaping carbonic gas to pass through a tube and bubble up through the water into the glass cylinder, and in this way I can collect a considerable quantity of this gas. Now, let me show you that this soda-water gas is capable of giving a precipitate with lime-water. I take another bottle of it, but instead of using a screw-tap, which is not necessary for the present experiment, I remove the cork in the ordinary way, and quickly insert in its stead a cork fitted with a glass tube, which has been placed in a hole bored through the cork. The gas which escapes from the liquid in the bottle passes through this tube, and we now have the gas bubbling up through the lime-water test, and converting it into chalk and water, just as did the gas we obtained in other ways.

This gas has another very important property; instead of using the ordinary strong lime-water I will take some far more dilute. I have put some of the strong lime-water into this jar, and now I will add to it a considerable quantity of distilled water. Here, then, is our diluted lime-water, and I now pass a current of carbonic gas rather quickly through this apparatus. The first effect in this case, as on previous occasions, is that we get our deposit of chalk, but I want you to watch the experiment, for you will find that the chalk which at first is apparent, entirely disappears after a little time. I can show you the same result in the case of soda-water. I will pour some lime-water into another of these glasses, and then empty into it a bottle of soda-water, and watch the result. You observe that the first effect is that the lime is converted into chalk, of which we obtain a considerable amount. Now I will add some more soda-water, and you will observe that the liquid becomes perfectly clear. Here, again, is another liquid in which chalk has been formed by the action of carbonic gas upon lime water. It is perfectly opaque, but if we add a little soda-water to it, the precipitate of chalk will eventually disappear. We have thus learned a fact entirely new to us—namely, that although, when we add carbonic gas to lime-water, we get insoluble chalk, yet if we continue to pass the carbonic gas through the chalky liquid, the whole of that chalk entirely dissolves after a certain length of time; so while chalk is insoluble in pure water, it is

perfectly soluble in water containing carbonic gas. Indeed, all our ordinary waters hold chalk in solution, held dissolved by means of the gas obtainable from charcoal.

Another fact with regard to the solubility of this gas in water is that, when we remove the pressure—that is to say, take the cork out of the soda-water bottle—we allow the escape of a considerable quantity of this gas, but we do not expel the whole of it. In order to do this we shall find it advisable to boil the water. In this flask we will boil some water containing carbonic gas. This is a bottle of soda-water from which we allowed all the gas to escape which would do so upon merely uncorking the bottle, and as the escape has gone on to that point, we will allow the water to boil in the flask, or rather we will apply heat to it, and you will find that the heat will drive off more of the gas, which, in the course of a minute or two, we shall have collected in a cylinder. I will allow it to heat rather rapidly, and you will see the gas bubbling up through the cylinder. You observe we are now driving off more of the gas by the application of heat. Now, just bear in mind what would happen if I took the cylinder and boiled the liquid containing the chalk, which was dissolved by the presence of carbonic gas in the water. The heat would drive off the excess of carbonic gas, just as we are forcing the carbonic gas off from the liquid in the flask. We ought consequently to have our precipitate of chalk manifesting itself in the solution; this is just what happens. We will boil that liquid, and you will see that when this is done it will deposit chalk on giving up its carbonic gas. [After an interval]—I will now ask you again to observe this liquid. You remember it was at first perfectly clear, but on boiling it has become opaque. The chalk which was held in solution by the carbonic gas has been precipitated as the gas became driven off by the heat. That deposit is nothing but boiler fur. Now, this [exhibiting a large broken kettle considerably furred inside] is not a very elegant article to bring before a Royal Institution audience; this kettle contains a large quantity of *fur*, consisting of the chalk which was dissolved in the water by the carbonic gas, and deposited on the inner surface of the kettle, when the carbonic gas was driven from the water by boiling. Chemically, this deposit is nothing more than marble. If I take a portion of this boiler fur and act upon it by heat, carbonic gas will be evolved, or, if I add acid, it effervesces very readily, and gives rise to the same gas.

We have now collected a rather large quantity of gas by boiling the soda-water. We will just ascertain whether this gas possesses the property of extinguishing flame. [A light was lowered into the jar containing the collected gas]. You see from this experiment that it *does*; thus, partly by merely removing the cork of the soda-water bottle, and collecting the escaping gas, partly by boiling the liquid, you see that we have procured a large quantity of carbonic gas, of which I will now exhibit to you some other remarkable properties. I have here a bottle containing gas; I take out the stopper, and still we have the bottle of gas. I will test its presence in the usual way, by introducing a lighted taper; the taper is at once extinguished, and though the bottle might be left open for a considerable length of time, still the gas would remain and the taper would be put out. Now, what does that suggest to us? Let me try whether I can perform a somewhat similar experiment with a glass of water. I will take this bottle containing a solution of salt. It is nothing more than common salt dissolved in water, and it is coloured so as to make it visible. Now I lower this bottle into a jar of colourless water: I do it carefully, so that the solution of salt mixes with the water as little as possible, and you see that the coloured solution of salt remains in the bottle, although it is at the bottom of the jar of water. It does not mix with the water to any appreciable extent, because the solution of salt is really heavier than the water above it; and just in the same way this carbonic gas remains in the open bottle, undergoing no very appreciable amount of mixing with the surrounding air, because it is really heavier than the air. I once more introduce the taper, and you see that the bottle still contains the gas, for the taper is extinguished. Now I will reverse the experiment, and take this glass bottle containing a liquid lighter than water—spirit of wine—coloured red. I will lower it into the jar of water just as I introduced the solution of salt,—but observe the difference of the result! See how the red liquid is streaming up to the top of the jar of water, and the colourless water is pouring into the glass which contained the spirit. Our carbonic gas is, therefore, in the position of this solution of salt, and not in that of the spirit of wine. You see that, introducing in this way the coloured spirit into the jar of water, I obtain two perfectly distinct layers of liquid. The water is beneath, and the coloured spirit at the top; you see I can draw off some of the latter from the upper part of the vessel.

I can show you some very curious effects of the weight of this carbonic gas, and I have here an experiment arranged for that purpose. In this bottle are two separate gases—carbonic gas and oxygen—the oxygen being in the upper part. I pass this lighted taper rapidly through the oxygen into the carbonic gas, and the flame is immediately extinguished. I raise it into the oxygen, and you see how readily the taper bursts into a flame and how brilliantly it burns.

Thus, you perceive that this carbonic gas is not only heavier than atmospheric air, but it is also heavier than oxygen, which will float on it. [The taper was extinguished and re-kindled several times in succession by being plunged into the carbonic gas, and then rapidly raised into the stratum of oxygen in the upper part of the bottle.]

Now I will make use of some liquids to illustrate to you the effects of these differences of weight. In this jar I have merely some water coloured red in order that it may be distinct, and through this water I want to pour a heavy liquid, namely, a solution of common salt, coloured purple, and by pouring this carefully through the funnel, I shall, in a little while, get a layer of purple liquid at the bottom. There is always a certain amount of mixing, but it will be so little that you will easily recognise the two distinct layers—a purple layer of solution of common salt at the bottom, and a red layer of water on the top. I think those who are near will see that we have already obtained these. I am, in fact, pouring a heavy liquid through a lighter one, and just in the same way I can pour a heavy *gas* through a lighter one, either by means of a funnel, or by another method which I will presently explain to you. If I take a liquid which is much heavier than water, I can pour it into water and form a distinct layer without any funnel. Here is some colourless water, and into this I am about to pour a liquid which is much heavier than the solution of salt, and which may therefore be poured without the funnel. This heavy liquid is oil of vitriol, and you see that in this way we get the colourless water at the top, and a stream of oil of vitriol descending to the bottom, and there forming a shading of blue.

Now I want to illustrate the same point to you by means of experiments performed with carbonic gas. Here is a cylinder of this gas coloured brown, and I will pour some of it into this cylinder of air. You will see it pass through the funnel and reach the bottom of the cylinder. It takes some little time to descend, but I can already see it pouring down. The funnel is now full of the brown gas, and sufficient has descended into the cylinder to answer our purpose. I have thus poured down our heavy carbonic gas, which was coloured brown; but I will now show you that I can not only pour carbonic gas through the funnel, but through the air without a funnel, just as I did the oil of vitriol through the water. I take this bottle of carbonic gas, and let a little of it flow upon the candle, and so put it out. Now I will pour some into this bottle containing lime-water. You observe that the lime-water is perfectly clear; but I now remove the stopper from the bottle of gas, and pour some of it upon the lime-water, and you see that we get an ample amount of gas. Let us try the weight of the gas in another way. Here is a pair of scales; you see that, at present, the counterpoise is a little too heavy, and goes down rather lower than the other side of the balance. I now open the bottle of gas and pour some of it carefully into the beaker attached to the scales, and the gas is so heavy that it actually turns the balance, and not only turns it, but keeps it down to a very considerable degree.

I will reserve for my next lecture some further illustrations of the extreme weight of carbonic gas.

NOTE ON THE UTILISATION OF CHROME ALUM.

By M. F. JEAN.

The manufacture of aniline green and violet, and of valerianic acid, gives abundant residues of chrome alum. These residues cannot be utilised as mordants, because, when calcined, they are insoluble in water, and therefore do not find a sufficient market, thereby considerably augmenting the net price of products prepared with bichromate of potash. Whilst endeavouring to turn these residues to account, I discovered that when chrome alum, previously mixed with three equivalents of carbon, is heated to redness, decomposition takes place as follows:—

$$SO_3KO,3SO_3Cr_2O_3+3C=3SO_2+SO_3KO+Cr_2O_3+3CO.$$

If, on the other hand, chrome alum be decomposed with seven equivalents of carbon, the evolution of sulphuric acid is less than in the first case, and the mass taken up by the water yields sulphide of potassium and hyposulphite of potash: the sesquioxide of chromium obtained under these conditions must be separated, by washing in acidulated water, from a certain quantity of sulphide of chromium, Cr_2S_3, formed by contact with the sulphide of potassium. It is better to decompose the alum with three equivalents of carbon than with seven, because the decomposition is quicker and purer.

The industrial treatment of chrome alum is very simple; it consists of pulverising and mixing the alum with the carbon, and then decomposing it at red heat in a retort of refractory earthenware. The sulphuric acid passes into a series of bitubular flasks, containing either distilled water, carbonate of soda, or polysulphide of sodium. When sulphuric acid is no longer liberated, the decomposition is ended. The obturator of the retort is then withdrawn, and the mass, consisting of sulphate of potash and sesquioxide of chromium, is caused to fall into a cast-iron boiler, water is added, and the whole is boiled to dissolve the sulphate of potash, which is afterwards separated by crystallisation; the sesquioxide of chromium is placed to drain upon cloths, and then calcined to remove the water that remains. This oxide may easily be rendered chemically pure by washing it in a boiling dilute solution of carbonate of soda, thus removing all traces of sulphuric acid which had escaped the action of the pure water. The sesquioxide of chromium obtained by this process is of too dull a green to be used for printing paper or textile fabrics; but, on account of its purity, and the ease with which it may be treated, it is perfectly adapted for making bichromate of potash.—*Comptes Rendus.*

Dr. Vintras.—His Imperial Majesty the Shah of Persia has conferred the honour of the Lion and the Sun on Dr. A. Vintras, Physician to the French Hospital in London, as a reward for the services which this distinguished physician has rendered to the Persian Embassy.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, February 18, 1869.

Dr. Warren de la Rue, F.R.S., President, in the chair.

The meeting opened with the usual formal business, after which

The President announced that the following gentlemen had been selected by the Council, and were recommended to the Society for election as officers, at the anniversary meeting:—As President—Dr. Frankland; as Vice-Presidents—Dr. Warren de la Rue, Dr. Noad, Dr. Odling, and Dr. Redwood; as Secretary, Mr. Perkin (in place of Dr. Odling, whose services had done so much to contribute to the prosperity of the Society); as Treasurer—Mr. Abel; as Members of Council—Mr. Maxwell Simpson, Mr. Chapman, Mr. Hanbury, Mr. Prestwich, Dr. Voelcker, and Mr. Greville Williams.

He (the President) had another announcement to make, which, he thought, would be extremely gratifying to the Fellows of the Society. The Council had had some anxiety in selecting a distinguished chemist to inaugurate the Faraday lectureship, recently established by the Society; it was felt, that, to do due honour to the distinguished philosopher whom we had lost, we could not do less than seek among the greatest names for one who would accept the duties for which the medal was to be conferred. The Council had applied in the first instance to M. Dumas, whose name was well known to every one present, who was a chemist before some of them were born, whose long career as a man of science, a statesman, and a promoter of the welfare of science, had been so distinguished, and who, above all, had been one of the most intimate friends of Mr. Faraday. M. Dumas had at last consented to accept this post, and this would, of course, necessitate a great number of preparations. A fitting arena for the discourse must be provided; and, through the instrumentality of Dr. Odling, arrangements had been made by which the theatre of the Royal Institution had been secured for the purpose. No site could be fitter for the purpose than that in which Faraday had enunciated so many of his grand discoveries. The discourse would, of course, be delivered in French; but that could be a matter of very little moment, as all the Fellows of the Society were probably acquainted with the French language. It was hoped that M. Dumas's visit to England might be rendered pleasant, and at a future time some little scheme would be laid before the Fellows of the Society by which a fitting welcome might be prepared for him. The discourse would probably be delivered in the month of May, but further information would be given to the Fellows in the course of six weeks or two months.

Professor Wanklyn then gave a verbal account of his experiments on ethylate of sodium. He had arrived at the result that the so-called absolute ethylate of sodium is really the hydrated oxide of a new kind of organo-metal. He had also obtained a set of salts of the new radical—for instance, the acetate, valerianate, and benzoate of ethylene-sodium. The formula of the first is—

$$\left.\begin{matrix}(C_2H_4Na)'\\C_2H_3O\end{matrix}\right\}O = \text{Acetate of ethylene-sodium.}$$

It is obtained by the action of acetic ether on absolute ethylate of sodium, thus:—

$$\left.\begin{matrix}C_2H_4Na\\H\end{matrix}\right\}O + \left.\begin{matrix}C_2H_5\\C_2H_3O\end{matrix}\right\}O =$$

$$= \left.\begin{matrix}C_2H_4Na\\C_2H_3O\end{matrix}\right\}O + \left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O.$$

Alcohol is, as will be observed, the complimentary product.

The new salts which are isomeric with salts of a higher fatty acid, are characterised by being decomposed by water into ordinary soda-salts and alcohol, thus:—

$$\left.\begin{matrix}(C_2H_4Na)'\\C_2H_3O\end{matrix}\right\}O + H_2O =$$

$$= C_2H_6O + NaC_2H_3O_2.$$

The elimination of alcohol in this reaction shows that the olefine is associated, not with the acid part, but with the metallic part of the compound. Mr. Wanklyn regarded sodium as triatomic in these compounds.

Mr. Chapman said that if the rotative amylic alcohol were taken, sodium dissolved in it, water added, and the whole distilled, an alcohol of the same rotative power was obtained; if, however, dry alcohol was treated with sodium, the alcohol distilled off, and the residue heated to about 200°, or rather over, this residue remained perfectly white and colourless, and had the composition of what was ordinarily called amylate of sodium. If water was now added, the alcohol yielded on distillation was no longer rotative. Its boiling point was lowered from 132° to about 124°; and the speaker was strongly inclined to believe that it was identical with the hydrate of amylene discovered by Wurtz. It did not yield valerianic acid on oxidation, and its specific gravity was altered. It would be somewhat curious if this observation, made almost at the same moment, were to receive explanation by Mr. Wanklyn's description of these olefine compounds.

Dr. Odling, without presuming to call in question the interpretation given to his researches by Mr. Wanklyn, whose powers of penetration into chemical phenomena were so well known, and who had had time to consider the subject carefully, remarked that it was easy to understand a difference between such a body as hydrate of sodium ethyl, or sodium ethylene, and ordinary sodium ethylate; but that if this sodium were replaced by hydrogen, he did not see how a difference could be figured between hydrate of a hydrogen ethylene and hydrate of ethyl—how, in fact, such a body could differ from common alcohol, unless, indeed, we were to give to the hydrogen a triatomicity corresponding to that which Mr. Wanklyn ascribes to sodium.

Professor Wanklyn thought that the explanation was that the sodium was combined twice with carbon, and if hydrogen were put in place of the sodium, he did not assume that the hydrogen would afterwards have the combining power that the sodium had. It amounted to this—that the sodium had interfered with the combination at two points, and so converted a normal into an abnormal action.

Mr. Chapman though that this anhydrous ethylate of sodium would yield common alcohol, whereas the anhydrous amylate, or amylene compound, would, in the same way, yield an abnormal alcohol. The splitting of the alcohol into olefine and water, or the representatives of water, appeared, as Mr. Wanklyn said, to be a result of the disturbance of the relations of the alcohol.

Dr. Odling remarked that Mr. Wanklyn appeared to think that the alcohol obtained by replacing the sodium of the ethylene compound by hydrogen, would differ from common alcohol,* whereas Mr. Chapman held a contrary opinion. If a different alcohol were obtained, under these circumstances its constitution could not be explained by our at present received notions. We should either have to assume that the atoms remembered, so to speak, the bodies which they replaced, or we must go into the question whether all the atoms of hydrogen in the methyl residue had the same value. This last notion was floating in chemists' minds, but had hitherto received no demonstration.

Mr. Mills thought that there was some ground for the opinion as to the identity of the different atoms of hydrogen in marsh gas, though perhaps he would not have ex-

* We believe that Professor Wanklyn did not intend to convey this impression.—Ed. C. N.

pressed the fact to which that opinion referred in exactly the same way. In the oil known as Marignac's oil, which was marsh gas, in which half the hydrogen was replaced by chlorine, and the other half by nitrile (NO_2), one-half of the nitrile had undoubtedly a different function from that of the other half, inasmuch as on heating with hydriodic acid, one-half became ammonia and the other half nitric oxide. A great deal of further support from fact would, however, be required before the floating opinion, to which reference had been made, as to a difference between the different hydrogens in marsh gas could be generally received; and when it was received it would not support any atomic hypothesis, but would, on the contrary, tend to a much greater result, namely, to make chemistry more dynamical and less statical than it unfortunately was at present.

The meeting then adjourned to Thursday, March 4th, when a lecture will be delivered by Mr. Tomlinson, F.R.S., "On Catharism, or the Effects of Chemically-Clean Surfaces."

PHARMACEUTICAL SOCIETY.

Wednesday, February 3, 1869.

T. H. HILLS, Esq., Treasurer, in the Chair.

Dr. ATTFIELD had already contributed three notes on the following subjects:—

Citrate of Quinine.—A mixture, consisting of sulphate of quinine, citric acid, citrate of potash and water, contained a deposit which prevented the proper apportionment of the dose; an analysis proved it to be citrate of quinine, and, by first rubbing the solid with a little of the water, a mixture was obtained which admitted of the proper dose being taken.

Aromatic Sulphuric Acid.—Experiments proved that the official preparation contained no sulphovinic acid, as had been supposed by some pharmacists.

The Adulteration of Precipitated Sulphur.—An analysis of eight samples showed that only one was pure, one contained nearly half its weight of calcareous matter, and each of the others contained two-thirds impurity, and only one-third precipitated sulphur.

At the present meeting, Dr. ATTFIELD read seven other notes: the first was on

Crystallised Carbonate of Magnesium.—Some unusually large crystals of pentahydrous carbonate of magnesium had been forwarded—the largest was 13 m.m. long, 9 wide, and 6·5 thick. They were converted, by exposure, into the terhydrous salt. ·324 of a gramme yielded, on analysis, ·0945 of MgO; 100 parts gave, by experiment, 29·167, and by calculation, 28,988.

Arsenical Playthings.—The author had analysed the wings of a toy bird, and also the label of a cotton reel, both of which contained arsenic; such toys should, therefore, be kept from the mouths of children.

The Separation of Tin from Antimony.—By the usual mode of separating these two metals, too little antimony and too much tin is often obtained. Noticing the best numbers were obtained when the operation was quickly performed, the author endeavoured to find out whether metallic antimony reduced ferric salts to ferrous, the antimony becoming dissolved by the influence of the excess of acidulous radical in ferrous salts over and above that in ferric salts. He warmed two solutions of chloride of antimony—one in a flask, the other in a beaker—adding to each metallic iron and hydrochloric acid. When the iron had disappeared, the flask was tightly corked and the beaker left uncovered. In forty-eight hours, the antimony in the beaker had re-dissolved; but on testing the liquor in the flask no antimony was discovered. On digesting finely powdered metallic antimony in solution of ferric chloride slow reduction to ferrous chloride took place, the liquid taking up antimony; so that, in precipitating antimony by iron, to estimate the amount of antimony, air must be excluded until all ferrous salt is washed away.

On a Crystalline Deposit in Opium Liniment.—On mixing a liniment often used in pharmacy containing laudanum, a greenish-yellow semi-crystalline precipitate formed, which was analysed to ascertain if it contained any of the active principles of the opium. It was found to consist of the acid meconates of potassium, and mainly sodium with a little sulphate of calcium; its presence was, therefore, of no moment.

In reply to a member, Professor ATTFIELD said it contained no morphia.

Mr. MORSON remarked that the morphia would be kept in solution by the ammonia.

Sulphate of Potassium in Ergot.—In preparing the Ext. Ergot Liq. B. P., a pharmacist had, after mixing the spirit of wine, set the mixture aside during a night instead of one hour. The sides of the vessel were lined with crystals, which Dr. Attfield found to consist of the inert salt of sulphate of potassium. They amounted in weight to about 3 per cent of the ergot employed. After reading the note, the author read a letter from Mr. Holloway, of Sydenham, who sent a sample of powdered ergot, which he had kept in a corked bottle since 1866, by adding about 20 per cent of spirit of wine; it was in a good state of preservation.

White Precipitate.—Six specimens were examined in reference to volatility, fusibility, and percentage of mercury: all volatilised on being heated, without leaving a trace of residue. On sublimation, one partially melted and one liquefied entirely, the others were infusible. The percentage of mercury was as follows:—

		Mercury in 100 parts.
No. 1. ..	volatile infusible ..	78·59
,, 2. ..	,, ,, ..	77·87
,, 3. ..	,, ,, ..	76·44
,, 4. ..	,, ,, ..	75·11
,, 5. ..	,, partly fusible	73·08
,, 6. ..	,, fusible	72·00

The author recommended that in the next Pharmacopœia the quality of infusibility should be included in addition to the percentage of mercury.

Mustard Cake.—Dr. ATTFIELD had analysed a sample of mustard cake which was prepared by pressing the husks of the seeds when hot. It was sold principally for manure, but farmers were liable to get it instead of linseed cake. The following is the analysis:—

Water	11·00	per cent.
Ash	8·00	,,
Fibrous matter	12·25	,,
Oil	14·00	,,
Albumenoid matter ..	31·70	,,
Mucilaginous matter ..	22·50	,,

Sulphurous Acid.—Mr. UMNEY read a laboratory note "On Sulphurous Acid," in which he showed that the officinal solution of 9·2 per cent could only be obtained with difficulty. The described specific gravity did not coincide with its percentage of acid. He had examined several specimens, and found they contained only from 2 to 6 per cent of real acid. Results of experiments on a large scale showed that the specific gravity of strong acid, as ordinarily obtained, was from 1·025 to 1·030. The author suggested that a solution of 1·027 sp. gr., and containing 5 per cent by weight, of real acid, be substituted for the officinal solution.

Mr. HANBURY had always found the strength of sulphurous acid inferior to that ordered in the Pharmacopœia.

Dr. ATTFIELD remarked that either the Pharmacopœia process or the percentage was wrong.

The CHAIRMAN thanked Dr. Attfield and Mr. Umney for their communications, and announced that the next meeting would take place on the 3rd of March.

FOREIGN SCIENCE.

PARIS, FEB. 24, 1869.

Lead *v.* Tin for Water Pipes.—Naphthaline Yellow.—Cholesterine in Wheat, Rye, and Barley.—Determination of the Density of Ozone.—Varnish for Iron.—Sulphate of Aniline a Test for Nitric Acid.

PUBLIC attention has often been directed to the dangers attending the use of lead pipes for the distribution of water. It is quite certain that some waters do dissolve traces of lead. The water obtained on board ships by the distillation of sea-water has been observed to contain lead when a worm of this metal has been used in its condensation. A description of a pipe invented by M. Hamon promises to obviate the chance of this contamination. M. Hamon makes use of a leaden pipe covered with tin; the covering of tin is not obtained by merely fusing tin on the surface of the lead, but by the simultaneous drawing out of two concentric cylinders of lead and tin. This operation is made by means of a hydraulic press under an enormous pressure, and the result is a homogeneous, compact, and unalterable material, which it would be impossible to obtain by other means. Pipes of this description are also far preferable to lead pipes for the conveyance of gas in houses. The ingenious invention of M. Hamon has been the object of several favourable reports from the Council of Public Health for the Seine, the Academic Society of Nantes, the Director of Naval Architecture, and several engineers.

M. Martius has published a note on the dye which is prepared with hydrochlorate of naphthylamine and nitrite of potash, and passes by the names of golden yellow and Manchester yellow. Some have considered this compound as dinitronaphthol or binitro-naphthalic alcohol—

$$C_{20}H_6(NO_4)O_2;$$

others consider it nitroso-naphthaline; others, again, consider it dinitronaphthol, $C_{20}H_6N$. Whatever the colouring matter may be, it possesses a considerable colouring power, and is fixed without any mordant on silk and cotton. In commerce, calcium or sodium are commonly combined with the colouring matter. It crystallises in little yellow needles, and behaves like a powerful acid; it may be purified by dissolving in ammonia and crystallising, and afterwards precipitating by a concentrated solution of chloride of ammonium. Boiling water scarcely dissolves a trace of the yellow colouring matter, which is only slightly soluble in alcohol, ether, and benzol. It decomposes carbonates, and gives, by double decomposition, salts which, in general, possess a yellow or orange colour; this colour is the ammonia salt, which crystallises in needles containing an equal quantity of water of crystallisation. Treated with tin and hydrochloric acid, this colouring matter gives a compound which the author considers as an isomer of alizarine.

The presence of cholesterine in wheat and rye has been observed by M. Ritthausen, and in barley by M. Lintner; the following process is described by the former:—The fatty matter obtained by the extraction with ether or hot alcohol is treated with a little ether to render the olein fluid, which is separated by filtering. The filter is drained, then washed with warm alcohol, which leaves a colourless residue; after boiling with a soda lye of 25 per cent, the residue is melted, washed with warm water, and dissolved in ether, which, after cooling, deposits plates of cholesterine. This proximate constituent possesses the following reactions:—Heated with sulphuric acid, or hydrochloric acid and sesquichloride of iron, it turns blue; it reddens when, after evaporation to dryness with nitric acid, ammonia is added; finally, after prolonged contact with sulphuric acid and chloroform, the solution becomes blue-violet tinted. Palmitine is the fatty matter of rye, that of barley is laurine mixed with a fatty principle intermediate between myristine and palmitine. Bran contains 3·5 per cent of fatty matter, while flour only contains 1 per cent.

M. Soret has made a determination of the density of ozone. Former experiments proved ozone to be an allotropic condition of oxygen, and to be denser than ordinary oxygen. When ozone is treated with oil of turpentine or oil of cinnamon, the diminution of volume is double the increase of volume which results when ozone is destroyed by heat. The conclusion to be drawn from this fact is, that the density of ozone is one-and-a-half times that of oxygen; other experiments tend to confirm this result. The rapidity with which ozone diffuses is considerably greater than that of chlorine, and very close (though a little feebler) to carbonic acid. M. Soret adopts 1·658 for the density of ozone.

Dr. Lunge has published a paper on "The Preparation of Varnishes for Iron as Secondary Products in the Distillation of Coal Tar." Varnishes of this description are very easily prepared by melting pitch with different matters obtained in the distillation. No substances other than those obtained in the distillation of tar are required, and all that is necessary in the manufacture is an iron vessel in a covered building. The form of vessel most convenient is a vertical cylinder slightly concave at the bottom. About as much pitch as would be contained in a three-quart vessel is thrown in at a time, and a small quantity of oil added to facilitate the fusion of the pitch and to prevent its solidifying on cooling. Considerable heat is then applied, and small quantities of oil added from time to time; before adding the whole of the oil, it is important that the melted mass should be allowed to cool sufficiently that the oil will not enter into ebullition. Exact proportions can be of no service, as different degrees of consistence are required for different purposes. Samples are withdrawn from time to time and allowed to become quite cold to judge of the consistence of the material. The oil employed is the heavy oil of tar, and for ordinary kinds of paint for metal, pitch is melted with it as previously described. But for many purposes, a simpler process still may be made use of, especially in the manufacture of large quantities. Tar is placed in small retorts (the ordinary retorts are too large for the purpose), and heated until the heavy oil commences to distil over; then the fire is diminished, and the retort allowed to cool somewhat; the retort is then opened, a certain quantity of heavy oil added, and the mixture well stirred: all that remains to be done is to pour the mixture out, and the operation is finished. Varnish made in this way is preferable to tar, and dries sooner; according to the state of the atmosphere it dries in twenty-four or forty-eight hours. By incorporating naphtha of the lowest quality—to do which the mass must still be warm—with the material made with light oil instead of heavy oil, a varnish may be obtained which will dry in an hour or less.

Sulphate of aniline, in the hands of M. Braun, has become an exceedingly delicate test for nitric acid. In a test glass about 1 c.c. of pure concentrated sulphuric acid is placed (1·84 density); to this is added, drop by drop, ½ c.c. of a solution of sulphate of aniline, prepared by adding 10 drops of aniline of commerce to 50 c.c. of sulphuric acid diluted in the proportion of 1 to 6. A glass rod is dipped into the liquid to be tested, and then into the mixture in the test glass. On moving the stirrer about gently, when the slightest trace of nitric acid is present, red streaks mark the course of the glass rod. Upon the least increase of the amount of nitric acid, the liquid becomes carmine tinted, and the addition of one drop of dilute nitric acid causes the liquid to become a deep red tint in the first case, and then reddish brown. This reaction enables the presence of nitric acid to be detected in commercial sulphuric acid. The author has also observed small quantities of nitric acid in well waters, and the same reaction has shown, most plainly, nitric acid in rain water after a storm. Hyponitric acid produces the same reaction as nitric acid, sharing in this fact the same defect as most of the other processes employed for detecting nitric acid.

NOTICES OF BOOKS.

Disinfectants and Disinfection. By ROBERT ANGUS SMITH, Ph.D., F.R.S., F.C.S. Edinburgh: Edmonston and Douglas. 1869.

BY common consent Dr. Angus Smith has become the first authority in Europe on the subject of disinfectants. To this subject he has devoted a large portion of his scientific life; and now, in a compact volume of only 138 pages, he has condensed the result of twenty years of patient study. We cannot too much commend the plan and execution of this enquiry. Almost every page contains evidence of exhaustive, laborious research, guided in its course by the clearest judgment. We seek in vain for some weak point to give us occasion to air our critical acumen. Our duty, therefore, must be confined mainly to giving extracts —criticism being out of the question—for no man living is competent to criticise Dr. Angus Smith on disinfection but Dr. Angus Smith himself.

This book contains within itself the whole subject of disinfection down to the present time. The author draws his information from all ages; he discusses the perfumed pomades of the ancients; the conserve of roses of the Athenians; the purification by fire of the Hindoos, of Hippocrates, and of Zeno of Constantinople; the labours of Hercules, who saved the Elians by draining their marshes; the embalming of the Egyptians; the sulphur fumigation of Ulysses; the anæsthetics mentioned by Pliny and Galen applied to surgical operations.—He discusses these with the more modern experiments of Dr. Petit, Sir John Pringle, Guyton Morveau, Dr. Carmichael Smyth, Fourcroy, Hildenbrand, Dr. Henry, and others; and, comparing their processes with those adopted in our own time, shows that throughout the immense mass of empiricism of a bygone time there runs a thin thread of gold, which he has interwoven with his own researches, and so raised the whole subject to the dignity of an exact science.

It is little surmised how much the ancients knew of sanitary subjects. That sewer air is unwholesome is a proposition which has taken in our time Commissions and Boards of Health many years of hard labour to din into the apprehension of the British public; yet even in Justinian's Digest, in quotation from Ulpian, it is evident that this question was then practically settled. Justinian says, "The prætor took care that all sewers should be cleansed and repaired for the health of the citizens, because uncleansed and unrepaired sewers threaten a pestilential atmosphere, and are dangerous." The world is obliged occasionally to revive its principles.

As an illustration of the exhaustive manner in which Dr. Smith treats his subject, weighing and balancing opinions like a judge rather than insisting upon them as an advocate, we may give the following quotation:—

"It has often been asked—Will a sewer produce cholera, or plague, or cattle disease? We cannot say so, or that every kind of disease may be produced from such accumulations of organic matter. The great epidemics that have passed over Europe seem always to have come from some extraneous source, to act as if planted by seed, and not to have risen up spontaneously here. Without attempting to examine this matter carefully, the result here would seem to be, that whilst the decomposition of organised beings after death produces gases and vapours that are opposed to health, these gases or vapours are incapable of originating, although they may be capable of feeding, some of those diseases, such as cholera or plague, which have been observed at all times to come from a warmer climate. There must, however, be some first origin of these diseases, and we cannot prove that the first origin might not take place in our climate, although it seems probable that it requires a warmer sun and a richer vegetation than is to be found in the north. This, however, is sufficiently made out—that, when these diseases do come amongst us, they take root with most effect in those places where decomposing matter is found. If we were to suppose a seed of disease planted in a rich, fertile soil of decomposing matter, we should give a pretty fair description of the fostering effect of impurity on disease. It would, in fact, appear as if the putrid matter itself took the disease, and transferred it to the living. There seems to be nothing entirely opposed to this view of the case. The question, however, is and has always been—What is the nature of that substance which may be said to form the seed or germ of the disease? Chemists have been inclined to consider it a substance in process of decay. Physiologists and microscopists have been more inclined to consider it as an organised substance. When Gay Lussac passed a bubble of air into the juice of grapes, and found that fermentation began at once, it was believed that the oxygen was the prime mover, and that, when once begun, the action did not cease. When, however, Dusch and Schroeder found that flesh did not decompose if the air was previously passed through a good filter of cotton wool, some difficulty was thrown on the subject. It would appear as if oxygen were not the only agent in the atmosphere causing decomposition. The investigations of M. Pasteur, who found the subject in this uncertain condition, have advanced it so far that we may now with certainty reason in the belief that organised substances are really found in great abundance in the atmosphere, and that they are the cause of some hitherto entirely mysterious phenomena, even putrefaction included. His object was first to inquire into the possibility of spontaneous generation, and he found that carefully filtered air allowed no organisms to appear in vegetable solutions. He found that near the usual surface of the ground these organisms were so numerous that whenever a vessel containing vegetable matter fit for their growth was opened for a very short time they were found to enter, that in cellars and damp and quiet places, where there was no air or dust floating about, these organisms were fewer, and that, as he ascended the sides of the Alps and the Jura, they diminished in number. A commission of the French Academy confirmed his results. If we examine previous inquiries into the compounds resulting from the decomposition of organic substances, we shall find nothing which is at all calculated to bring out such an intelligible rational view of the origin of many diseases, and also of some phases of putrefaction. Chemists, when they have examined products of the latter action, have found sulphuretted hydrogen, carburetted hydrogen, hydrogen, carbonic acid, nitrogen, ammonia, acetic acid, lactic acid, butyric acid, and numerous uncertain bodies having no activity, and utterly incapable of producing those prodigious results that are found when that force begins to work which produces plague, small-pox, or black death."—(p. 20).

Incremation has been advocated of late as a means of obviating the danger occasioned by the multiplication of dead bodies in and about large cities: Dr. Angus Smith puts the subject in a new light:—

"Many people think that we ought, like some of the ancients, to burn our dead. They do not consider what a terrible proposal they are making. To burn a body without producing the smell of burning flesh is a most difficult thing, and far surpasses the problem of burning our smoke, which, however important, is still left undone. The expense of keeping up such a lake of fire as to consume all our dead would also be, in all probability, too great; let us imagine 1500 bodies roasted to ashes in London every week. We shall not enter into the details of such a large manufactory of phosphates, as we must call it, because it is painful to dwell on the horrors of the picture, and conjure up the details."—(p. 5).

Many other quotations we should like to give, but since every page contains subjects of interest and value, to quote

all the noteworthy passages would be to reprint the book.

To sanitary officers, to municipal and parochial authorities, and indeed to all who are practically concerned for the public health and life—and who is not?—we sincerely commend Dr. Angus Smith's treatise.

Hints to Purchasers of Jewellery and of Watches, with an Account of the Relative Value of the Different Qualities of Gold. By EDWIN W. STREETER, 37, Conduit Street, Bond Street. Tenth Edition. London: Simpkin, Marshall, and Co.

THIS neat little work should be studied by all purchasers of jewellery, for in nothing can the inexperienced be so easily duped as in the purchase of gold and silver ornaments. The first part of the book contains some valuable hints on quality and workmanship which, if adopted, will soon lead to the public obtaining a fair value for their money. With regard to the quality of gold, our author very properly remarks that "*Colour* is no guide, as it may be gilded; *weight* is no guide, as it may be loaded with lead; *pattern* and *finish* tell for nothing to the inexperienced eye," but to prevent deception, the purchaser has only to make himself familiar with the standard estimates and to request that the quality be stated on the invoice. The stamp of Goldsmith's Hall is thought by most persons sufficient security, but this is not the case with gold, for the same acts of Parliament allow gold to be marked and sold from standard of 22 carat, worth £3 17s. 10½d. per oz., to an alloy containing gold of 1 carat, worth only 3s. 6d. per oz.

The second part contains a most interesting description of the manufacture of jewellery and watches by machinery. The space allotted to this notice will not allow of our commenting more at length on this division, suffice it to say that a presentation watch seen by us and made entirely by machinery at Mr. Streeter's Establishment proves the great advantages gained by economising labour and thereby greatly reducing the cost.

This readable little book is beautifully printed on fine toned paper and we commend its perusal to our readers.

CORRESPONDENCE.

HEATON'S STEEL AND IRON.

To the Editor of the Chemical News.

SIR,—In the last number of the CHEMICAL NEWS, I find you state that neither of the bars of steel designated as 10 B or 10 C in Dr. Miller's report have been analysed, and that it remains to be proved how far the impurities in the crude steel had been eliminated by the subsequent treatment it was subjected to. In reference to this remark I beg you will allow me to state that two of the bars of hammered cast-steel, made in the experiment conducted by Dr. Miller and Mr. Mallet, were analysed by me some weeks since, and the results as to the amount of phosphorus were communicated to the Chemical Society at the meeting on the 21st of January. Those bars had been tested by Mr. Kirkaldy as to their tensile strength, and are referred to in his report as Nos. 1077 and 1082. The amounts of phosphorus found in them were ·241 and ·240 repectively, as stated in the CHEMICAL NEWS of the 29th of January.*

I will take this opportunity of mentioning that the fallacy which your correspondent, Mr. Williams, ascribes to me, in reference to this subject, exists only in his imagination. No opinion was offered by me as to the quality of the steel, and my communication was restricted to pointing out the fact that steel of considerable tensile resistance contained an amount of phosphorus much larger than had previously been observed to exist in steel of good quality.

According to the statement of Mr. Williams, he would appear to be master of an amount of knowledge and opportunity of judging respecting this subject which do not fall to the lot of most chemists, therefore it might perhaps be regarded as presumption on my part to endeavour to justify myself in regarding the tensile strength of steel as a character which the presence of phosphorus would be most likely to affect, provided the commonly received opinion as to the influence of that substance on steel be correct. For this reason I will not venture to offer any reply to Mr. Williams's letter, but will merely express my hope that, in his next communication, he may, from the abundance of his resources, confer upon chemists the benefit of somewhat more fact and less opinion.—I am, &c.,

BENJAMIN H. PAUL.

8, Gray's Inn Square.
February 24, 1869.

* Vol. xix., p. 58.

SPURIOUS GUANO.

To the Editor of the Chemical News.

SIR,—Many of your agricultural readers will doubtless be interested to learn that a material now offered for sale at the price of £11 per ton, under the attractive title of "Biphosphated Peruvian Guano," is not Peruvian guano at all, but a manufactured article, which, from its composition, presents a greater resemblance to superphosphate of lime, of a value less than one-half the price asked for the material which is now offered under a name calculated to convey the idea that it is even superior to true Peruvian guano, though it does not contain much more than one-third the amount of ammonia generally present in this manure, and an amount of phosphates no greater than would be present in superphosphate at about £3 per ton. The sale of trashy manures is now so extensive that this instance of the practice may be worth your notice. —I am, &c.,

BENJAMIN H. PAUL.

MISCELLANEOUS.

A Brilliant Idea.—The *Scientific American* contains the following suggestion to Baron Von Liebig:—"Justus Von Liebig, the celebrated German chemist, recently told a friend that, during the last ten years, he had received seven calls from American universities, and that twice he felt strongly tempted to go to the United States and accept there a Professorship. We trust that Liebig will visit this country and give our people the benefit of his varied stores of information; but we cannot advise him to cover up his light under the bushel of a college professorship. If the Baron wishes to make his name and fame conspicuously useful, he had better accept a position upon the editorial staff of the *Scientific American*, through whose columns he could reach and educate a hundred thousand minds each week."

Poisonous Dyes.—M. Tardieu, the celebrated French chemist, has made some interesting and important experiments with red stockings imported from England. After extracting the colouring matter, he introduced a certain quantity of it beneath the skin of a dog, which died in twelve hours. A rabbit similarly treated expired in eight hours, and a frog in four. Opening the animals, M. Tardieu re-extracted the red colouring matter from their

bodies, and with it dyed a skein of silk. In his report, communicated to the Académie des Sciences, M. Tardieu condemns the use of the "coraline" (the mineral (*sic*) poison to which the fatal stockings owe their brilliant but deceptive hue) as an article of general commerce; and recommends that the importation of red stockings from England be absolutely prohibited.—*Manchester Guardian.*

The Zirconia Light.—The Paris correspondent of the *British Journal of Photography* gives the following account of this light, with which some parts of Paris are now illuminated:—"On Saturday evening I had the pleasure of seeing the experiment of lighting, by means of the oxyhydrogen light, as applied to towns, &c. It was the third time I had been to the Tuilleries in order to see this illumination so that I could report to your readers, and I am able to report most favourably as regards the general effect. The most striking peculiarity of this light, as perfected by MM. Tessie du Mothay and Maréchal, is its perfect steadiness and freedom from flicker. It was the first remark made to me by a bystander—"How steady the light is!" The zirconia cylinders or balls are placed inside the ordinary street lamps, and the jet of mixed gases plays upon them. The light, although very brilliant, is not so painful to the eye as the electric light, and diffuses itself better. You see a globe of pure white light, about the size of a large marble, perfectly steady, and throwing its moonshine rays all around. The contrast between the lamps lit up with this light and the ordinary gas jet is very striking in two particulars, and I had the opportunity of comparing them side by side. The gas-light is yellow, wavering, and flickering, and comparatively dull; the zirconia light is white, steady, no flicker, and brilliant. I have seen many attempts to introduce the electric light for lighting streets, &c., but it is too penetrating, and the light is blinding, even at a distance, to those who are making towards it; and everything, except in the rays of this light, are in total darkness. The effect is like that of a policeman's lantern, which enables him to see all before him, but which keeps him and his surroundings hid from all in front of him. The zirconia light is free from this defect. The question is, can the oxygen gas be procured cheaply enough, and this is asserted in the most positive manner."

Ecole Pratique des Hautes Etudes, Paris.—The new school and the laboratories at the Sorbonne, which have been fully described in the *Journal of the Society of Arts*, were expected to be opened in the course of January. M. Milne-Edwards, Dean of the Faculty of Sciences, has recently made a report to the Academic Council of Paris upon the progress, with one important change, made in the arrangements for the new high school and laboratories. The faculty already is in possession of two physical laboratories, one for instruction under Professor Desains, in which candidates for the degree of Licentiate or Doctor may learn the management of instruments of precision, and exercise their faculties in the repetition of classical experiments relative to heat, light, electricity, magnetism, and acoustics. The rooms set apart for this purpose have been found in three old houses, close to the Sorbonne, and placed temporarily at the disposition of the faculty, and they will very shortly be opened four times a week to the pupils. The second physical laboratory is for scientific investigation, and is installed in a new building erected by the municipal authorities expressly for the purpose: this is under the direction of Professor Jamin, and was opened in the middle of last summer. The large chemical laboratory, under the direction of M. Sainte-Claire Deville, assisted by M. Schulzenberger, was to be opened early in the present year. The practical study of mineralogy is to be carried on in the study of M. Delafosse, once a week at first, but afterwards twice, if necessary. There are provided two geological laboratories, both under the charge of Professor Hébert, and to be opened twice a week. The study of botany is to be divided between the Sorbonne and the Museum of Natural History at the Jardin des Plantes; the laboratory of the faculty, directed by Professor Duchartre, to be devoted to dissection, microscopic examination and analysis. A new arrangement has been made with respect to the study of comparative anatomy, which will be divided between the Jardin des Plantes, the Collége de France, and the Sorbonne, the dissection of animals being studied at the first of these establishments. With respect to experimental physiology, a laboratory is now being arranged by M. Claude Bernard, but on a scale much too small for the purpose, but which will doubtless soon be enlarged. Lastly, says M. Edwards, the faculty intends to complete its arrangements by the opening of a reading-room, in which the students of the new high school may consult the various scientific periodicals, and make use of the time that will necessarily elapse between the lessons; for this useful object the professors have given up their common room until a new one can be provided. It is quite evident that the Minister of Education and the learned Dean of Faculty are determined to carry out the intentions of the government with vigour, and it would be the fault of the young men themselves who are devoted to scientific persuits if they do not make progress, not only in educational, but in original investigation. The professors are the most celebrated in France, and the means provided are such as no university in the world offers for high scientific study. It will be strange indeed if a field so well prepared, and in such good hands, should fail to be fruitful.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News." A more complete list containing the omitted papers and contents of journals devoted to other branches of science, is published at the Patent Office, in the library of which the periodicals themselves may be consulted).

Comptes Rendus.

November 23, 1868.

P. A. FAVRE, "Researches on Electrolysis." F. P. LE ROUX, "On the Behaviour of the Native Chlorides of Sodium and Potassium towards some Metallic Vapours and especially towards the Vapour of Sodium." CHABRIER, "Researches on Nitrous Acid." F. FOUCOU, "On some Gases Evolved from Petroleum Wells situated in different parts of North America." F. FOUQUE, "On the Composition of the Gases mentioned in the preceding paper." E. GRIMAUX, "On Cinnamate of Benzyl." G. VILLE, "On the Presence of Sulphate of Ammonia in the Lagoons of Tuscany." PINCUS, "Note on the Author's Claim to the Invention of the New Constant Battery described by Warren de la Rue and H. Müller."

November 30, 1868.

E. BECQUEREL, "On Diffusion, Electro-capillary Phenomena, the Formation of Oxides, Silicates, Crystallised and Hydrated Aluminates, and on the Effects of Diffusion between Liquids which do not mix with each other. H. DEVILLE, "On the Temperature of Flames, and on its Relations to Pressure." P. DESAINS, "Researches on Obscure Calorific Spectra." BONJEAN, "Note on the Therapeutic Properties of Ergotine." FRITZSCHE, "On some New Hydrocarbons." "On a Phenomenon resulting from the Fracture of Tin when Exposed to Intense Cold." STAS, "An Improved Method of Testing Silver in the Wet Way." F. JOLYET and A. CAHOURS, "Note on Crum Brown and Fraser's Memoir on the Physiological Action of the Salts of Methylstrychnium."

Poggendorff's Annalen.

No. 10. 1868.

F. WIEDEMANN, "On the Magnetism of Chemical Compounds." O. E. MEYER, "An Explanation of B. Stewart and P. G. Tait's Experiment on the Heating of a Disc by Rotation in Vacuo." A. KUNDT, "On the Spectrum of Lightning." A. POPPE, "On the Form of the Flame of Bunsen's Burner." H. GEISSLER, "Some New Experiments on the Production of Light in Vacuum Tubes."

Annales de Chimie et de Physique.

October, 1868.

P. SCHUTZENBERGER, "Memoir on the Colouring Matters extracted from Persian Berries." A. BOBIERRE, "On the Action of Sea Water on the Sheathing of Ships, and on the Methods of Investigating the same." F. KUHLMANN, jun., "On the Extraction of Sulphur from the Solfataras of Sicily." BERTIN, "On some New Induction Machines." E. JUNGFLEISCH, "Researches on the Chlorinated Derivates of Benzine."

Bulletin de la Société Chimique de Paris.
November, 1868.

BERTHELOT, "On the Direct Transformation of Marsh Gas into more Condensed Carbides." "On the Hydrides of the Hydrocarbons." "On some Modes of Formation of Styrolene." E. KOPP, "On the Condensation of Hydrochloric Acid Gas in the Manufacture of Chemical Products."

Journal für Praktische Chemie.
November, 1868.

C. JESSEN, "On the Constituents and Decomposition of Starch Grains." J. LOWE, "On Catechu and Catechu-Tannic Acid. W. STEIN, "On the Colouring Matters extracted from Persian Berries." G. LEUCHS, "On the Valuation of Indigo." LIEBEN, "On the Synthesis of Alcohols by Means of Chlorinated Ether. F. GOPPELSRODER, "On Melopsite."

NOTES AND QUERIES.

Dyes from Ochella Weed.—Can you or any of your correspondents inform me what is the distinctive character of the tinctorial matters recently prepared from ochella weed, under the names orcine, orceine, eriphthine, and eryphic acid? How do they differ from archil and cudbear, and from each other, and how are they made?—CHROMO.

Picrate of Quinine.—Aniline Black.—Can you inform me, through "Notes and Queries," if picrate of quinine has been used as a medicine, and what dose, and what effect? Also, if there is an aniline black for cotton—I can find none in any published work. I want to find it, if the process exists.—NEW BERNE.

Utilisation of Waste Heat.—"W. F. K. Stock" is referred to the work "Abridgments of Specifications relating to the Preparation and Combustion of Fuel, A.D. 1620—1865," published by order of the Commissioners of Patents, 1867. One volume in octavo, 1409 pages, price 17s. May be inspected at the library of the above-named Commissioners.

Austrian Non-Explosive Blasting Powder consists of 30 per cent of nitrate of potash, 40 per cent of nitrate of soda, 12 per cent of sulphur, 8 per cent of charcoal, 4 per cent of pit-coal, and 6 per cent of tartrate of potash and soda. This powder is explosive only when it has been rammed tight, and is then ignited by means of an explosive fusee. It is in very general use in the mining and quarrying operations in the Austrian Empire, and is far less expensive than ordinary blasting powder.

Chemistry of Food.—Charles Hunter.—This correspondent, in reducing the "grains per lb." to percentages, according to tables 3 and 4 of Dr. Letheby's lectures (see vol. xviii., pp. 79 and 80), found a difference in the tables. In table 4, beef is said to contain 2301 grs. of carbon and 175 grs. of nitrogen per lb.; whereas, from table 3 giving 72 as the percentage of water, our correspondent judges that the total solids could not exceed 1820 grs.; according to his calculation, 16 is the percentage of N in albumen, 52 the percentage of C in albumen, and 48 the percentage of C in fat. Dr. Letheby has, with his usual courtesy, sent us a very full explanation, which we subjoin, for the benefit of all our readers, as well as our special correspondent. Dr. Letheby says:—"In the first place, your correspondent has not used the right numbers in any of his calculations; for the pound referred to is an avoirdupois pound of 7,000 grs., and the percentage proportions of carbon in fibrin, &c., and fat, are 53 and 77, instead of 52 and 48, while the percentage amount of nitrogen in the nitrogenous matters of meat is 15·4 instead of 16. But, even with these proportions, it is quite true that the amounts of carbon and nitrogen in table No. 4 do not in all cases correspond with the calculated proportions from table No. 3. To take the case in point, lean beef and fat beef of table 3 would have the following amounts of C and N per lb.:—

	C. grs.	N. grs.
Lean beef	910	208
Fat beef	2155	160
Mean	1537	194

Neither of which numbers agree with those for beef in table 4; and the discrepancy arises from the circumstance, that in most cases the numbers in table 4 were obtained by actual analyses. Beef, however, like all other flesh, differs very considerably in the relative proportions of water, nitrogenous matter, and fat; and it would seem, from the proportions of carbon and nitrogen in table 4, that the beef must have contained the following percentage proportions of fat and nitrogenous matter:—

Fat	31·6 per cent,
Nitrogenous matter	16·2 ,,

And these proportions are not very different from the proportions which Messrs. Lawes and Gilbert found in the carcasses of half-fat and fat oxen; for, in their paper in the *Transactions of the Royal Society*, they give the following as the percentage amounts in the two cases:—

	Nitrogenous matters.	Fat.
Half-fat ox	17·8	22·6
Fat ox	15·0	34·8
Mean	16·4	28·7

Dr. Edward Smith says, in his "Practical Dietary," that, on taking equal parts of beef and mutton, and a fair sample of the joints, and deducting one-tenth of the weight for bone, we find that there are 2650 grs. of carbon and 157 grs. of nitrogen in each pound' (p. 79). So that, taking all the numbers in the several cases, it would seem that the proportions of carbon and nitrogen per pound of meat stand thus:—

	C. grs.	N. grs.
Fat beef (table 3)	2155	160
Mean of Lawes and Gilbert	2155	177
Beef and mutton (Smith)	2650	157
Mean	2320	165
Beef (table 4)	2301	175

And, considering that Smith's proportions of carbon are a little too high, and the nitrogen a little too low, on account of the mixture of mutton with the beef, it may be fairly assumed that the amounts which I have given for beef in table 4 are very near the truth."

MEETINGS FOR THE WEEK.

MONDAY, March 1st.—Medical, 8. Annual Election.
—— London Institution, 6.
—— Royal Institution, 3. General Monthly Meeting.
TUESDAY, 2nd.—Royal Institution, 3. Rev. F. W. Farrar, "On Comparative Philology."
WEDNESDAY, 3rd.—Society of Arts, 8.
—— Pharmaceutical, 8.
THURSDAY, 4th.—Royal Institution, 3. Dr. Harley, "On Respiration."
—— London Institution, 6.
—— Royal, 8.30.
—— Chemical, 8. C. Tomlinson, F.R.S., "On Catharism, or the Effects of Chemically Clean Surfaces."
—— Royal Society Club, 6.
FRIDAY, 5th.—Royal Institution, 8. W. Huggins, Esq., "On some Further Results of Spectrum Analysis Applied to the Heavenly Bodies.."
—— Geologists' Association, 8.
SATURDAY, 6th.—Royal Institution, 3. Dr. Odling, F.R.S., "On Hydrogen and its Analogues."

TO CORRESPONDENTS.

Chemicus.—This correspondent, who wanted to know of a good work on pigment colours, is informed that a letter is waiting for him at our office.

F. E. S. Jerningham.—We regret our inability to furnish information respecting Winter's electrical machine.

Knife Edge.—An angle of 30 degrees appears a little too acute for an agate knife edge; we have seen them as obtuse as 60°, and work very well.

H. H. G.—Hopkin and Williams.

G. E. D.—You seem to have read nearly all the books we could recommend.

D. John.—The product of one distillation at 100° C., will be very far from pure benzol. The benzol should be separated from the naphtha by fractional distillation, and then purified by freezing.

H. How.—The article received with thanks; it shall be inserted in an early number.

Communications have been received from L'Abbé Moigno; A. Steel; J. Rothschild; Professor H. How, Nova Scotia; D. John; R. Berry; H. Noyes; J. J. Lish; C. G. Williams, F.R.S.; J. Spiller; Professor Wanklyn; Professor Heaton; H. Hudson; R. R. Tatlock; Professor Brazier; Professor Attfield; W. T. Suffolk; Dr. E. Fleischer, Dresden; F. E. S. Jerningham; C. Hunter; J. Barrow; Dr. Paul; Miss Lydia Becker; W. Neill and Son; A. Maurice; W. Mackenzie; W. White; G. H. Brown; A. Carter (with enclosure); The Runcorn Soap and Alkali Co. (with enclosure); Mawson and Swan; J. Simpson; L. Demuth and Co.; J. W. Lumley; N. Lincoln; J. F. Dickson; J. M. Dluith; T. De La Rue and Co.; Professor Hinrichs, Iowa City, U.S.; Dr. Muter (with enclosure); W. Cass; W. H. Perkin, F.R.S.; F. Sutton, F.C.S.; H. D. Collingwood; Lumsden and Son (with enclosure); B. Wheeler (with enclosure); T. Geeves; J. and W. Rickard (with enclosure); Burnard, Lack, and Co. (with enclosure); Dr. Andrews (with enclosure); Albright and Wilson (with enclosure); and Dr. Odling, F.R.S.

BOOKS RECEIVED.

Causeries Scientifiques, Découvertes et Inventions, Progrès de la Science et de l'industrie. Ouvrage orné de 72 vignettes et d'une Chromolithographe, Huitième Année. 1868. Paris: J. Rothschild, Editeur.

The Law to Regulate the Sale of Poisons within Great Britain. By William Flux. London: John Churchill and Sons.

More Light! a Dream in Science. London: Wyman and Sons.

Report of the Manchester Scientific Students' Association, for the year 1868. Manchester: Cave and Sever; Ed[illegible]

Braithwaite's Retrospect of Practical M[illegible]win Slater.

LVIII., January. Uniform Americ[illegible]edicine and Surgery. Part [illegible]ond and Adams.

[illegible]an edition. New York: Town-

American Reprint of Chemic[illegible]al News. February.

THE CHEMICAL NEWS.

Vol. XIX. No. 483.

SETTING TO WORK.

Bad as man is, he is too good to be quite pleased with the present—too good not to feel sympathy with the struggles of the past, and too good not to hope for a better future. The present we see, so far as our eyes permit us; the past we almost see beside us, in nations that have little changed; and the future seems to be forming almost before our eyes. In a very wonderful picture of the English race moving over the world with cities of civilisation as numerous as the tents of those former men who carried desolation before them, we learn in Mr. Dilke's "Greater Britain," that, even west of the Mississippi, 22,000,000 of acres of land have been devoted to the purposes of education, and millions on millions are to follow. The whole of England and Wales contain only 38,000,000 acres of land not so rich, but all that American expanse is at once made sacred. As a result of a similar policy in Michigan, a university has arisen, which teaches for a sum which may be considered merely as an acknowledgment of its position—10 dollars for entrance, and 5 dollars annually afterwards. Michigan is of the same size as England and Wales: it has 38,000,000 acres. This our country has turned into many by a kind of gemmation, and principles grown amongst us, but not carried out, are flourishing among people whom circumstances, perhaps, have enabled more honestly than us to do as we feel we ought to do. We see our future growing not far away, but it seems to us as a kind of martyrdom to enter it. It is already a law that no man shall die for lack of bread; it is not yet a law that no one shall sink into worse than death for lack of teaching. But we must arrive at this point—our nature decides for it. We compel every child over whom we have influence in private life to learn, and, as our hearts enlarge, our influence will widen its circle.

This expansion has shown itself lately. The exertions of private men have been incredibly great, and the work which some have done places them so high that we can no longer doubt that even our generation can produce heroes that no age would despise. But the work has been insufficient; a private man among thousands does good, but it is too little, and the man dies of exhaustion, or at least by time. An agent from the Government comes, the people crowd around him, he is received with delight, and the work is done to the extent required—and sometimes further—in any department to which the Government turns its attention. There are two departments of education, which show what local interests can do and what Governments can. The church, of which we are not authorised to speak, has been preserved by the state, without loss of income and in full power. The schools for the young, left by individuals, or in the hands of small irresponsible boards, have gone, in numerous instances, to ruin. We cannot argue fully the whole subject, but we think these facts give fair arguments. In Scotland, the parish school system, also, has been preserved, because defended by Government. It may be said that the parish schools have not grown with the age: it is true; but they have not had their small stipends used for feeding the wealthy, and growth has not been entirely absent. Had provision been made for growth, the system had been perfect.

And now what is Government to do? And are we to begin to be the ten-thousandth instructor of Government, and lay down a plan which we suppose all men will follow? No, we do not intend to lay down systems for the nation; we think that peculiarly the work of legislators—of men who know the mode of carrying out principles among their fellow men. We prefer to speak less ambitiously; we think it proved, by the experience of some three hundred years, that the state can take care of revenues for education. Can it also take care of education? On this point, most people will say that it has done so too rigidly, and that an expansion from time to time was desirable. A judge was told by a barrister that a certain act demanded that a large disputed sum should be unreservedly in the hands of a very young claimant. What said the judge? "Am I going to allow a young man to be ruined, simply because of some words in an Act of Parliament." Here was discretion. All men are not capable of a wise discretion; and the constant opposition to everything proposed has prevented movements which the spirit, but not the letter of laws, dictated.

To keep up the standard of education is really the business of the universities, and to them we must look for examiners. There is no man more important than an examiner; he rules the youth of to-day: he has more influence on them than all the previous and existing thinkers of the world besides. To please him, the young men read, and they learn his ideas; he has his opinion—he even has his crotchets, and they are received with respect. This is an evil that arises from one set of examiners, and a reason why a nation must have several. The same reason applies to universities. France prefers to carry out one idea—to model her schools on one pattern; there is something grand in it. One only can be perfect, and why, then, have two patterns. It is the perfect way of the heavenly future, but can be right only for a nation that cannot go wrong. To make many millions think on one model, is, one would suppose, the surest way to suppress originality. It will have its effect; there must be many tastes among many minds. We believe that one great university will mould a nation more thoroughly than many will; but we prefer the waywardness and eccentricity that are the diseases of men of original character to that uniformity and smoothness which we think will be produced by the military school system.

In the fulness and freedom of our universities, we shall have, perhaps, the best guarantee of the education being the most advanced. When untrammelled in teaching, and their revenues guided, they may not become so disinclined to move as in past times. When public opinion itself sinks, who is to raise it? When new branches of knowledge arise, who is to provide for the new teachers? If all the funds are given to those of to-day, there must be less to each if the numbers are increased to-morrow. In such a case, there is the plan well known—first come first served; and there is the other plan, not unknown either—to give Benjamin the largest share. There are, also, intermediate plans, if no other funds can be got; but is anything sadder than to leave untaught a great department of knowledge, simply because the funds are already granted to men who have never served any but themselves.

It is hoped that no such questions will again arise, but that a free intercourse between the state and the universities will cause abundant provision to be made for all laudable pursuits. As a rule, men will fight for themselves; and it is a fault of a nation if it allows laws which incite men to resist the public good in order to advance even their moderate wishes. Men commit crimes sometimes from want of knowing that better results could be got for themselves without crimes.

Surely if a state preserves or gives the property, the universities may give the learning. If any of these should become wild, and teach doctrines opposed to the nation's better feelings, the state must interfere, but not otherwise; toleration ceases with all men at some point. No one discusses the propriety of murder—the question is settled; but we discuss capital punishments, because there are wise men of opposite opinions. To what body is it possible to give this lofty supervision, except to the state.

which, moreover, by the will of nations, takes it of a necessity.

But if the property is thus preserved, and the learning secured, what shall be done with both? At present, the principal inclination is to encourage study by prizes and scholarships. We believe, that by a simple minute at the end of 1867, the Government has decided the fates of the children for many years to come; they will learn more science—they will change the character of the nation; there will be a greater audience for words lectured or read, and the national mind will speak more strongly on scientific objects.

We have begun by encouraging scholars with money; in England monied men send their sons where money prizes can be got. We teach the child to read by a sweetmeat; but this may last too long. If it endures three centuries, like some of our educational habits, so much the worse for this country. In America, it is already ceasing, competition for prizes being considered hurtful; and in a great university, which does not even take money for teaching, it is unseemly for students to fight for mere gain.

We should prefer to see more rewards given to those who had spent their strength and their lives, serving their age by their studies; we think that this class of reward ought to increase, whilst student rewards diminish. Many a precious life has been destroyed by long fellowships without duties, and many have been rendered unhappy by having the aid removed at a time of life when it was most required. It seems proper, and according to natural law, that the finished student should, as a reward, have work given him; that is the true fellowship. We could point out students under twenty making so much money by prizes that it would be considered as a very handsome pension by old scientific men. Yes, we could point out one who has written papers by scores, and spent thousands of pounds on science, who would be glad of it. True, these student incomes do not last above two or three years; but fellowships last longer, or, on certain conditions, for life. At this moment there are men who have devoted themselves to various branches of science, ready at all times to give their knowledge to all who ask for it; we must confess that we should prefer fellowships going to such men rather than to those who were only eminent students. The reward of the student arises from an old idea that he who had studied a master had completed his knowledge; the modern idea has a boundless nature before it, and he who has finished his university studies is only beginning his career. The student has life and hope before him; study is a privilege now, in an intellectual age when we need rather to diminish the desire, lest the brain should suffer, and when men row or run as a discipline, instead of as in ancient times making a business of sports. We know the opposing arguments, but we still say—give work to the young and rest to the old. For ourselves, we believe that a house must be very poor that has not a warm corner for the oldest, who has done his work or the greater part of it; and the hearts in it must be poorer still if they do not delight in giving to such the finest delicacies at meals. Many severe and true things have been said against sinecures, but no civilised man ever included such as these. Families must have them; no nation with a clear intellect can be without them, because, even without a heart, it may see its advantage in rewarding well done work. We believe that in this direction rewards for scientific men would be wisely increased rather than for mere students. The chimney corner of the nation must be kept warm.

We know well another side. What is finer than to see the adventurous youth struggling for a prize whereby to live, that he may study, and, by pure force of genius, lifting himself out of poverty and hopelessness to honour and applause. We hope prizes for this purpose will continue in our universities until poverty shall cease; but when one has learnt, make him work.

Of course there are many other modes of viewing the subject; we may take one becoming very popular of late, we may call it the Fijian. The aristocratic party of a Fiji island held that a man at forty, having lost his agility, might, for economy's sake, be eaten. It is easier in those places to tell when a man is of value than it is with us; they can measure the amount of food he brings home, but the value of our men may be in a single thought, and we treasure the individual, listening as to an oracle, not knowing what effects on the world the next word may cause. Even in an economical point of view, we object to the Fijian method. A little sickness or headache is often followed by a long time of great activity; but we have heard of a young Fijian, who had somewhat lost her appetite, and, looking out of her hut, saw at the door her grave, into which she was thrust, and covered up by the work of five minutes. We adopt Fijian policy in many cases here, when a man is paid by the number of strokes he gives a hammer, and when tired is sent off to seek in the workhouse the only compassion that a nation can give by deputy. It seems needful in many cases, because we must struggle against deception; but as men rise in the scale of humanity, the hard reasoning ceases to guide them, because reason is unable to estimate the value of a good man.

These points are all interesting, but we must not go too far aside from the main interests of scientific men. The greatest favour which a nation can do them is to give them employment, each according to his kind. Perhaps some may suppose that we are now going to devise situations for them, and propose to clamour that all these shall be filled up instantly, so that no longer shall men of science be without honour and comfort. Well, if we could, we would situate them all well; and, after all, there are not so many in the nation as to make the burden too heavy. But it is not to be done: they must fight like other men—"man must go out among his foes working and struggling." Still we ask—How shall a nation best make use of that peculiar power obtained by the study of science; how shall it organise those invisible forces, as it has organised the army and navy, and the equally invisible courage of the human heart, that prompts ever to resist aggression? These great questions must be settled for national, and not merely private benefit, and then more time will be given for warming the chimney corner, which, after all, is not the least of things.

It has taken many centuries to reduce an army to order—its equipments have been changed in our own day; and the navy is now in process of change. Since Marcus Graecus burnt saltpetre, sulphur, and charcoal, and made something like a rocket project, the changes have been many, the principle one.

We have gone to Alexandria for our systematic scientific beginning, and the museums of Europe are parts of the system begun of old. Perhaps our British Museum is the truest model we know. These museums are increasing over the country. They are becoming associated with parks; and a beautiful beginning of this kind we have in that admirable spot at Kew. It does seem to us that to add learned persons in real life to these institutions is a true policy. These places offer fine opportunities for lectures, and it is a question whether it is not well to imitate Paris in her Jardin des Plantes, and have these lectures free. A thousand objections arise; we know most, but we know something also of the people of England, and we are persuaded that the logic of facts is always sure to find among them ready listeners, whilst they are ever ready to make flights by that most delightful of methods, a train of thoughts. These lectures ought not to be profound. We hear lecturers complain of want of attention. If you speak Greek, how do you expect English people to understand you, even if they have been at a university? The profoundest thinker may find it hard to teach the meanest child. People imagine that it is because he knows too much, but this is a mistake, it is because he knows too little. He has passed in a kind of balloon, or in an inflated sort of way a whole region of thought, the

very region which the child wishes to travel, but the poor thing can get no guide; and by degrees it is of necessity driven to take the same balloon passage, or some night conveyance. Let the truth told be worth thinking of, and earnest men will come; let them be interesting to the imaginative, and light thinkers will come; let them be cheerful as nature is cheerful, and the gayest will come. Already children are rising up that require science among their thoughts; and the active intellects that are growing more numerous will do evil if not good. We think this a fine field for scientific work. We have few towns with scientific men in them. There is a dreary lack of them in many places, and it is absolutely needful to fill up this lack as salt is to preserve meat. We have torn down the superstitions of our ancestors that filled their active minds; we have taken from our Northmen and Celts their numerous and interfering spirits, and removed from them the society of the spirits of the dead and the wandering doubles of the body; we have taken away the interesting fairies, trolls, and brownies, and we have stopped the mild and merry adventure that brought glory on the sea, and frightened the sea-board from Thule to Constantinople. It is true we have taught the duties of a calmer life, and we desire no longer to return to the past and its faith, but we feel the need of substitutes for the imagination and for the bodily, active, and porpoise-like delight which made our dreaded ocean a place of rest to rovers. The nation makes to itself a substitute by roaming over the world, but the many at home want interest also, and there is more than enough for any man, in science, art, and general progress. We have seen men pining in country places, in villages, and even in large towns, and we are convinced that, by good teaching, double power could readily be produced in this nation. The old arms are useless; we must make the new ones and distribute them.

The teaching of science in schools, and keeping it alive in museums, seem two important methods now begun. Let benevolent men further them. These are not the only modes: some time ago a movement was made to induce corporations to appoint scientific men—chemists—to analyse food, and to see that it was sold in purity. This was a fine opportunity of diffusing science and its benefits. Will town councils refuse it because, perhaps, the analyst will not have enough to do? It is an opportunity for having a scientific man to consult; and he might be rendered useful in many ways to men who are far too much inclined to go on their own judgment, which, of course, can only be the average of intelligent—not specially trained men. Food alone will not occupy the time probably. It is a much to be lamented thing that scientific advisers are so constantly rejected or ignored in the government of cities. We think the chemist particularly required: his life has been looked on as a parasite of medicine, but he is really a separate man. We are unable to tell the many things for which a chemist might be useful in a city, but if he only prevented houses and and whole cities being built with bad bricks and mortar, he would be worth his weight in solid gold, and much more.

The work is not for any one class of men. Meteorology and astronomy, so often going together, are beginning to come more actively into daily life than usual. The use of the latter is old; and the State has made by its aid guides for the sea, and even for the land. Its younger sister is now rising into fame, and the museum will never be complete without an establishment that is always so interesting to Englishmen, and which promises to give us some knowledge of the regions of the air, and to guide us in commerce and in agriculture, which at present so peculiarly demand our attention. And here we come round to chemistry again, brought by our numerous shipwrecks. Does it not seem strange, that a nation that depends so much upon iron should not be able to tell the composition of a good ore, or of a sound piece of metal? Few iron companies, that we know of, keep a chemist constantly occupied with the subject, and men in London, for the love of pure science, must find whether there ought to be phosphorus in good steel or not. It would be wise for the iron-masters to keep a dozen chemists on high salaries, analysing for years, until the results amounted to thousands. Generally, they desire the results in a few days, and made as cheaply as possible. The results may be of no value for years, but valuable they will be; and if iron-masters care little for the future, we can only hope that this question is one which will be taken up by the nation, and that, for the sake of commerce, manufacturers, and that part of humanity which suffers from wrecked iron vessels, boiler explosions, and breakages of machinery, such inquiries shall be made as shall settle these questions for ever, although a century may be needed for the investigation.

ON

ENGLISH AND FOREIGN ALKALIMETRICAL AND CHLORIMETRICAL DEGREES.*

By JOHN PATTINSON, F.C.S.

THE relations between English and foreign alkalimetrical and chlorimetrical degrees are but little known amongst merchants, chemical brokers, and others, who are in the habit of exporting large quantities of alkali, soda-ash, and bleaching powder; and it is a remarkable fact, that, even in many of the laboratories of our chemical works, these relationships are very imperfectly understood. It is a common mistake to suppose that the alkalimetrical degrees of Decroizille represent percentages of carbonate of soda; then, again, both English and foreign chemists who are unacquainted with the usages of the soda trade, erroneously take for granted that the English soda test is based upon the most recently established atomic weight of soda—31.

Doubtless, the want of knowledge on this subject is owing to the almost entire absence from our chemical handbooks of all information on the matter. I am not aware of any English book which gives the value of Decroizille's degrees; and in very few English books treating on alkalimetry is there any mention of the use of the atomic number, 32, as a basis for the test for soda in the English soda trade. I have also found a similar want of information on the relation between French and English chlorimetrical degrees, very few of our handbooks mentioning the French method of stating the value of a sample of bleaching powder.

As may be easily conceived, the want of information on these matters, in trades of such magnitude as our soda and bleaching powder trades, is a fruitful source of misunderstanding and dispute. It appears to me that our young Society, established in the midst of one of the great seats of these trades, is a fitting medium through which to diffuse the requisite information. With a view to further this object, I have made the necessary calculations, and arranged two comparative tables—one showing the relations between the amounts of soda, carbonate of soda, English degrees, and Decroizille's degrees; and the other, the relation between French and English chlorimetrical degrees. I am indebted to M. Kuhlmann, of Lille (himself a large soda manufacturer), for the correct statement of the value of Decroizille's degrees. (See next page).

It is, doubtless, highly desirable, for the sake of scientific accuracy and uniformity, that the atomic weight of 31 for soda, instead of 32, should be adopted in England as a basis for the test for soda. It is, however, always difficult to alter trade usages, and there are good reasons why this one should not be hastily changed. It gives to the manufacturer an advantage of 0·65 of a per cent on a 50 per cent alkali—that is, an alkali testing 50 per

* Read before the Newcastle Chemical Society, January 28th, 1869.

COMPARATIVE TABLES
OF
ENGLISH AND FOREIGN ALKALIMETRICAL AND CHLORIMETRICAL DEGREES.

Alkalimetrical Table.

Percentage of Soda.	Carbonate of Soda.	English Degrees.	Decroizilles' Degrees.	Percentage of Soda.	Carbonate of Soda.	English Degrees.	Decroizilles' Degrees.	Percentage of Soda.	Carbonate of Soda.	English Degrees.	Decroizilles' Degrees.
30·0	51·29	30·39	47·42	46·0	78·66	46·60	72·71	62·0	106·01	62·82	98·00
30·5	52·14	30·90	48·21	46·5	79·51	47·11	73·50	62·5	106·86	63·32	98·79
31·0	53·00	31·41	49·00	47·0	80·37	47·62	74·29	63·0	107·72	63·83	99·58
31·5	53·85	31·91	49·79	47·5	81·22	48·12	75·08	63·5	108·57	64·33	100·37
32·0	54·71	32·42	50·58	48·0	82·07	48·63	75·87	64·0	109·43	64·84	101·16
32·5	55·56	32·92	51·37	48·5	82·93	49·14	76·66	64·5	110·28	65·35	101·95
33·0	56·42	33·43	52·16	49·0	83·78	49·64	77·45	65·0	111·14	65·85	102·74
33·5	57·27	33·94	52·95	49·5	84·64	50·15	78·24	65·5	111·99	66·36	103·53
34·0	58·13	34·44	53·74	50·0	85·48	50·66	79·03	66·0	112·85	66·87	104·32
34·5	58·98	34·95	54·53	50·5	86·34	51·16	79·82	66·5	113·70	67·37	105·11
35·0	59·84	35·46	55·32	51·0	87·19	51·67	80·61	67·0	114·56	67·88	105·90
35·5	60·69	35·96	56·11	51·5	88·05	52·18	81·40	67·5	115·41	68·39	106·69
36·0	61·55	36·47	56·90	52·0	88·90	52·68	82·19	68·0	116·27	68·89	107·48
36·5	62·40	36·98	57·69	52·5	89·76	53·19	82·98	68·5	117·12	69·40	108·27
37·0	63·26	37·48	58·48	53·0	90·61	53·70	83·77	69·0	117·98	69·91	109·06
37·5	64·11	37·99	59·27	53·5	91·47	54·20	84·56	69·5	118·83	70·41	109·85
38·0	64·97	38·50	60·06	54·0	92·32	54·71	85·35	70·0	119·69	70·92	110·64
38·5	65·82	39·00	60·85	54·5	93·18	55·22	86·14	70·5	120·53	71·43	111·43
39·0	66·68	39·51	61·64	55·0	94·03	55·72	86·93	71·0	121·39	71·93	112·23
39·5	67·53	40·02	62·43	55·5	94·89	56·23	87·72	71·5	122·24	72·44	113·02
40·0	68·39	40·52	63·22	56·0	95·74	56·74	88·52	72·0	133·10	72·95	113·81
40·5	69·24	41·03	64·01	56·5	96·60	57·24	89·31	72·5	133·95	73·45	114·60
41·0	70·10	41·54	64·81	57·0	97·45	57·75	90·10	73·0	134·81	73·96	115·39
41·5	70·95	42·04	65·60	57·5	98·31	58·26	90·89	73·5	135·66	74·47	116·18
42·0	71·81	42·55	66·39	58·0	99·16	58·76	91·68	74·0	136·52	74·97	116·97
42·5	72·66	43·06	67·18	58·5	100·02	59·27	92·47	74·5	127·37	75·48	117·76
43·0	73·52	43·57	67·97	59·0	100·87	59·77	93·26	75·0	128·23	75·99	118·55
43·5	74·37	44·07	68·76	59·5	101·73	60·28	94·05	75·5	129·08	76·49	119·34
44·0	75·23	44·58	69·55	60·0	102·58	60·79	94·84	76·0	129·94	77·00	120·13
44·5	76·08	45·08	70·34	60·5	103·44	61·30	95·63	76·5	130·79	77·51	120·92
45·0	76·95	45·59	71·13	61·0	104·30	61·80	96·42	77·0	131·65	78·01	121·71
45·5	77·80	46·10	71·92	61·5	105·15	62·31	97·21	77·5	132·50	78·52	122·50

The first column contains percentages of soda, calculated on the correct atomic weight—31. These also represent what are known in France as Gay-Lussac's degrees.

The second column contains the amounts of carbonate of soda corresponding to the soda in the first column. Soda ash is sold in Germany, Russia, &c., by the percentage of carbonate of soda it contains.

The third column gives the corresponding percentages of soda according to the English test, which is based on the old atomic weight of soda—32—still retained as a trade custom in England.

The fourth column shows the corresponding degrees of Decroizilles' alkalimeter. These degrees represent the number of parts of monohydrated sulphuric acid (oil of vitriol) which can be neutralised by 100 parts of the sample under examination. Decroizilles' degrees are used in France and some other parts of the Continent.

Note.—In the commercial testing of samples of soda ash and alkali, all the soda neutralised by test acid is taken into account, and reckoned as soda in the mode of stating the results shown in the first and third columns, as carbonate of soda as shown in the second column, and as degrees as shown in the fourth column.

Chlorimetrical Table.

French Degrees.	English Degrees.	French Degrees.	English Degrees.	French Degrees.	English Degrees.	French Degrees.	English Degrees.	French Degrees.	English Degrees.	French Degrees.	English Degrees.
63	20·02	74	23·51	85	27·01	96	30·51	107	34·00	118	37·50
64	20·34	75	23·83	86	27·33	97	30·82	108	34·32	119	37·81
65	20·65	76	24·15	87	27·65	98	31·14	109	34·64	120	38·13
66	20·97	77	24·47	88	27·96	99	31·46	110	34·95	121	38·45
67	21·29	78	24·79	89	28·28	100	31·78	111	35·27	122	38·77
68	21·61	79	25·10	90	28·60	101	32·09	112	35·59	123	39·08
69	21·93	80	25·42	91	28·92	102	32·41	113	35·91	124	39·40
70	22·24	81	25·74	92	29·23	103	32·73	114	36·22	125	39·72
71	22·56	82	26·06	93	29·55	104	33·05	115	36·54	126	40·04
72	22·88	83	26·37	94	29·87	105	33·36	116	36·86	127	40·36
73	23·20	84	26·69	95	30·19	106	33·68	117	37·18	128	40·67

The French degrees represent the number of litres of chlorine gas, at 0° C. temperature (32° Fah.) and 760 m.m. barometric pressure (29·92 inches), which can be obtained from 1 kilogramme of the sample of chloride of lime (bleaching powder) under examination.

The English degrees represent the actual percentage of available chlorine contained in the sample under examination. This mode of stating the results is used in Germany, Russia, America, &c.

cent by the English test, only contains 49·35 per cent of actual soda. In the London market, it is also an established custom in the alkali trade to pay for parcels of goods only on the whole degrees, and not on the fractions, so that an alkali which contains 50·9 per cent of soda, by the English test, is invoiced and paid for as only containing 50 per cent. It will thus be seen that the disadvantage to the manufacturer of the latter custom just about counterbalances the advantage gained by the former. It would, obviously, be unfair to alter one custom, and leave the other in force. Another trade custom, affecting the chemical manufacturer to his disadvantage, is that of assuming the amount of peroxide of manganese contained in a sample of manganese ore to be equal to the two atoms of carbonic acid evolved when the ore is tested by the ordinary oxalic acid process. These peculiar trade customs in analysis are a very frequent cause of misunderstanding and annoyance, and it would be well if they could be abolished in favour of methods which all chemists admit to be correct, according to the present state of chemical knowledge. I am of opinion, however, that these changes can only be effectually made by the chemical trade itself, and I recommend the subject to the consideration of the Alkali Makers' Association. But so long as these trade customs continue in use it is desirable that exact information as to their nature, should be attainable by all persons interested in the trade. The table here given will help to do this, so far as relates to the English soda test.

In making the calculations for the chlorimetrical table, I have adopted the combining number of 35·46 for chlorine, as given by Stas and Marignac, and have taken 0·08961 gramme as the weight of a litre of hydrogen at zero centigrade and 760 m.m. pressure. The weight of 1 litre of chlorine, at the same temperature and pressure, is, therefore, 3·17763 grammes.

ON THE IMMEDIATE ANALYSIS OF DIFFERENT VARIETIES OF CARBON.

By M. BERTHELOT.

(ABSTRACT)

THIS method consists of oxidising carbon at a low temperature and examining the product obtained. Under these conditions

1st. Diamonds, whether black or of the common kind, are not sensibly oxidised even by repeated and prolonged treatment.

2nd. The different varieties of amorphous carbon are completely transformed into humoid acids of a yellowish brown colour, soluble in water. The properties of these acids vary according to the kind of carbon which produces them.

3rd. The different varieties of true graphite are changed into corresponding graphitic oxides; the properties of these oxides also vary according to the nature of the graphite whence they are obtained, but all are characterised by their insolubility and especially by their capability of being quickly decomposed, with deflagration, by the action of heat.

This is the mode of operation:—Mix with the powdered carbon five times its weight of chlorate of potassium previously pulverised, and gradually form into a sort of paste with fuming nitric acid; leave it for some hours in a small open flask, and then heat it for three or four days without intermission to about 50° or 60° C.; after this dilute it with water and wash by decantation with tepid water until the salts of potash are dissolved. It is generally necessary to repeat the process five or six times, or even more, in order to produce either of the results above mentioned.

The different varieties of carbon may thus be distinguished by studying the products of their oxidation. I believe this will also lead to the separation of graphites and amorphous carbons into several distinct groups, but this subject demands further inquiry. I propose henceforth to reserve the name of *graphite* exclusively to carbons which furnish a graphitic oxide, thus avoiding former ambiguities; the new mode of analysis is applicable not only to pure carbon but also to the mixed varieties.

1st. In the case of a mixture of amorphous carbon and diamond, the amorphous carbon is entirely dissolved after a few repetitions of the process, while the diamond remains unaltered.

2nd. In a mixture of graphite and amorphous carbon, the amorphous carbon is completely dissolved after repeated treatment, whilst the graphite gives rise to an insoluble graphitic oxide of a yellow or greenish yellow colour, decomposable with deflagration. The graphitic oxide may be decomposed, as will be shown, in such a way as to cause the disappearance of the whole of the carbon.

3rd. In a mixture of diamond, graphite, and amorphous carbon, the amorphous carbon is entirely dissolved, leaving a mixture of graphitic oxide and diamond; this cannot be dissolved by solvents, but the diamond may be isolated as follows:—

Dry the mixture, then heat it in a tube closed at one end; the graphitic oxide is destroyed, leaving pyrographitic oxide; this reoxidised by chlorate of potash and nitric acid, forms soluble products, and a proportion of graphitic oxide much smaller than that first destroyed.

On decomposing this new graphitic oxide by heat, and then reoxidising the new pyrographitic oxide, only traces of graphitic oxide will be discovered. After three or four operations, the whole of the graphitic oxide will disappear, leaving only the diamond. Certain hard and crystalline powders formed by silicates or silica, and which occasionally occur as the last residue, must not be confounded with the diamond powder. The employment of fluorhydric acid, combined when needful with water and concentrated nitric and sulphuric acid, will cause the entire disappearance of this kind of residue.—*Comptes Rendus.*

Absinthe.—It appears that until 1864 the belief that there was nothing injurious in absinthe except the alcohol was general enough. In that year, however, a mad doctor named Marcé communicated a paper to the Academy of Sciences, in which he demonstrated that the essence of wormwood was contained in the liquor called absinthe in the proportion of twenty grammes of essence to 100 litres of alcohol, and argued that this essence had a peculiarly injurious effect on the brain. In 1867 a petition was presented to the Senate, praying that the sale of absinthe might be absolutely forbidden. Nothing came of it; and now the "question of absinthe" has been once more brought forward by two physicians, MM. Magnan and Bouchereau, who, for the first time, have made regular scientific experiments with the questionable stuff. The object of the experimentalists was to show what the effect of pure alcohol would be on a guinea-pig, and what the effect of absinthe. With this view they placed a guinea-pig under a glass case with a saucer full of essence of wormwood by his side, another guinea-pig being placed under another glass case with a saucer full of alcohol. The guinea-pig, who, so to say, was being "treated" with absinthe, sniffed at the fumes, and for a few moments seemed, like the absinthe drinker before mentioned, "supremely happy." Gradually, however, he became heavy and dull, and at last fell on his side, agitating his limbs convulsively, foaming at the mouth, and presenting all the signs of epilepsy. The same epileptic symptoms were manifested on the part of a cat and a rabbit who, in a similar manner were made to inhale the fumes of absinthe. On the other hand, the guinea-pig who was forced to get intoxicated with pure alcohol behaved like an ordinary drunkard. He became lively, then reeled about, and at last lay down and fell into a heavy sleep.—*Pall Mall Gazette.*

ON THE

CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(Adapted to a Juvenile Auditory),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,

(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE IV.

Carbonic Gas, or Fixed Air.

(Continued from p. 101.)

Here is a jar full of carbonic gas, the presence of the gas being shown by the immediate extinction of a lighted taper; the jar is apparently empty, but in reality it is full of gas. If I wanted to empty it of any liquid it might contain, there are several methods to which I might have recourse; of course the most obvious one would be simply to pour it out. I will first see if I can pour anything out of this jar on to the taper. [The jar was tilted over a lighted taper, which was at once extinguished by the invisible gas.] You see we have poured something out. We will try it in another way. Here is a bottle of lime-water, and we will see whether we can pour into it any gas from our jar. I just hold our apparently empty jar over the lime-water, and then shake up the lime-water, and you see it is at once converted into a mixture of chalk and water; this is the most usual way of getting a liquid out of a jar. There is another method, to which we may very easily resort. I will pour out some of the gas upon the candle in another way; I first pour some of it into a beaker, and then from the beaker on to the candle, which is thus at once extinguished. This is another illustration of the mode of getting this heavy gas out of the jar—by simply pouring it. Now we will adopt some other methods. I again light the candle, and, instead of pouring out the gas, I will bale it out. I take a glass cup, and introduce it into the jar of carbonic gas, thus abstracting a quantity of it, which I will pour from the cup into the lime-water; I then shake up the lime-water, and you see that I have in this way actually conveyed some of the gas into the bottle of lime-water. Now I will try whether some more of the gas can be baled out from this jar, and a candle extinguished with it. I fill the cup with the gas, and pour it upon the candle; and you see that at once the flame goes out.

If I wanted to empty out of a large jar like this, any liquid it might contain, I could, as I have reminded you, pour out the liquid as I did at first, or I could bale it out; but there are other methods still which might be employed. You must all be familiar with the syphon, and you have, no doubt, seen it in use in the streets, in front of public houses, for the purpose of drawing off spirits from the casks into the large measures. Now let us try whether we can in the same way remove any carbonic gas from this jar; we will first fill our syphon, and then see if we can syphon off the gas. I apply the syphon; and you perceive that, by its means, we can cause the gas to flow upon the candle, and at once put it out. I now take a little lime-water, and upon this I allow the syphon to empty itself for a few instants. [After a short pause]—It has gone on long enough, I have no doubt. I therefore place the stopper in the bottle of lime-water, and, on shaking it up, the lime is immediately converted into chalk. I have syphoned off the gas, and this proves to you that it is heavy, and can be treated like a liquid; we can either pour it out, bale it out, or syphon it out.

Now let me give you one or two further illustrations of the weight of carbonic gas, and for this purpose I will take it as it is contained in soda-water. Here is an empty bottle,—that is to say, a bottle containing nothing but air; I will pour into it some clear lime-water, and then endeavour to act upon that lime-water by the gas evolved from our bottle of soda-water, and at the same time I shall have an opportunity of showing you the weight of the gas. I have already once or twice put out a candle by the gas evolved from soda-water, and this experiment I intend to repeat; but this time I will pour the gas upon the candle, and so show you its weight. When I extinguished the candle by means of the gas from soda-water, we had not considered the weight of the gas. I just open the soda-water bottle, carefully, and first I will try the action of the gas upon the lime-water. I take a funnel, and into it I pour some of this carbonic gas that it may descend into the lime-water. I simply pour the gas, without any of the water which is contained in the bottle, and you see that we have formed a reasonable amount of chalk by means of the gas that we have thus poured upon the lime-water. [The lime-water was shaken, and became turbid, indicating the presence of carbonic gas in the bottle.]

Now let me call your attention to another mode of getting out this gas, and for that purpose I will use this larger cylinder, which is now being filled with the gas from the supply

* Reported verbatim, by permission of the Author, for this Journal.

down stairs; we will ascertain whether the jar is full. You see it is so, for on introducing the taper, the light is at once extinguished. You know that another very common way of emptying a large vessel of water is to use a tap. Now here is our large jar really full of gas, although it looks as if it were empty. I just close the tap by putting my finger upon it. We will first of all draw off a little of the gas over a bottle of lime-water, into which I now let some of the gas run. I have no doubt that the bottle now contains sufficient for our purpose. I shake it up, and you see we get a similar result to what we did with the soda-water. I will take another bottle, and this time, instead of allowing the gas to run directly into the bottle, I will let it run into the beaker so as to fill it, and then I will pour its contents into the bottle. I hold the glass beaker carefully under the tap so as to catch the gas, and now that it is sufficiently full I close the tap with my finger, and pour the gas contained in the beaker into the bottle. I shake up the bottle, and here again you see our clear lime-water is converted into a mixture of chalk and water. I will now allow the gas from the tap of the jar to flow upon a candle, and you see that as it does so the flame is at once extinguished by it. Here is another candle, upon which I will also let the gas pour down, and I may call your attention at the same time to the force with which it issues from the jar. You see that in this instance it blows out the flame of the candle before completely extinguishing it in its usual way. I will now allow the carbonic gas to fall upon a flame of ordinary coal gas, and in this case also the flame is extinguished. Now I will endeavour to catch some of this gas by letting it pour into a beaker, and then try to pour it from the beaker on to a candle. You see our vessel was completely full, for when I pour the gas on to the candle the flame immediately goes out. I will now give you another illustration of the weight of the gas. In this instance, instead of bringing the candle to our barrel, I will bring the barrel to the candle. Having done so, I remove my finger from the tap, and you see the light is at once entirely extinguished. We will try the same experiment with a gas jet. I bring the barrel of gas to the jet, and when I remove my finger the flame is at once blown out. The fact is, the gas is pouring out from this tap with considerable force, as is proved by its action on the flame. Again, I collect some of the gas in a beaker, and wait until there is reason to believe that the vessel is full. Having now got sufficient gas for our purpose, I empty the beaker on to some lime-water, and on shaking up the lime-water you see that a quantity of chalk is formed.

So much, then, for these illustrations of the way in which this heavy gas may be got from a vessel by all the ordinary processes that are employed for getting water out of a vessel. I refill our large jar for another purpose. You will remember that at a former lecture we had a cylinder apparently full of only one liquid—water—though in reality it contained two; the lower liquid was water, and the upper one was spirit, floating upon the water. You may perhaps recollect the means by which we ascertained the line of demarcation between the two fluids. We dropped in a piece of wax, which sank through the spirit; but when it came to the surface of the water, it immediately floated upon it, showing us the height to which the water reached. Now I can show you a somewhat similar experiment with this gas in this large jar, and you will see to what height the carbonic gas reaches. Instead of taking a piece of wax as I did when we were experimenting with the water and spirit, I will take a balloon—one of those toys with which we are all familiar. You see this balloon will not fall very quickly through the air, but still it would fall down to the ground in a moment or two if we allowed it. [A small india.rubber balloon distended with air was placed within a large cylinder, partially filled with carbonic gas. The balloon sank a short distance down the cylinder, and there floated on the surface of the invisible carbonic gas, indicating the height of the gas in the cylinder.] You see very clearly that the balloon floats on the surface of the carbonic gas just as the piece of wax did on the surface of the water. If I knock the balloon down through the carbonic gas, it will not keep down, but rises to the surface of the gas. I will try one more experiment illustrative of the weight of this gas, to bring these experiments to a conclusion. I will now put into the jar another balloon, heavier than the former. It will gradually sink, and thereby indicate to us the pouring out of the gas. You will see from the fact of the balloon sinking lower and lower, that the jar is getting more and more empty. The gas from this jar is gradually pouring out into the cylinder below, and this we can prove by inserting a lighted taper into the lower vessel. The taper goes out.

Spirit From Lichens.—Mr. Stenberg has just made some experiments with a view of converting the cellulose of certain species of lichens, which are very common in Sweden, into glucose and alcohol. The species *Cladonia rangiferina* yielded the best results. Boiled for twelve hours with water containing 12½ per cent of sulphuric acid, this lichen yielded 68 per cent of glucose; fermented and distilled, the spirit obtained was found to possess a peculiar flavour of almonds (hydrocyanic acid ?), but was not otherwise disagreeable; the glucose isolated and examined had a very disagreeable flavour. Many lichens are poisonous; and all, especially those met with in northern climes, contain a very bitter tasting principle.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 26th. 1869.

R. ANGUS SMITH, Ph.D., F.R.S., Vice-President, in the Chair.

"*On Microscopical Examination of Dust,*" by J. B. DANCER, F.R.A.S.

The author stated that he had made some microscopical examinations of dust collected in June, July, and August last, and also of the particles contained in the rain water after the long drought. He had intended to bring these observations before the Society in a complete form, but has not hitherto found time to do so. He proposed to carry on observations during every month in the year, for the purpose of recording the average amount of solid matter deposited on a given area, and also as far as possible to ascertain the character of the deposits. The observations so far have shown, as might have been expected, that the dust in various localities, at different altitudes, and under other varying conditions, contained particles differing in magnitude, appearance, and quantity for the same superficial area. In every instance molecular activity was abundant, but the animal life was very variable in amount, the largest number of moving organisms being in the dust collected at the lowest points—this was about five feet above the surface of the earth. This dust also contained the largest proportion in magnitude and quantity of vegetable matter. These observations also show that in thoroughfares where there are many animals engaged in the traffic, the majority of the light dust, which when disturbed reaches the average height of five feet, or about the level of a foot passenger's mouth, consists of a large proportion of vegetable matter which has passed through the stomachs of animals, or which has suffered partial decomposition in some way or other. This is not an agreeable piece of information, but it is a fact. It shows the necessity, in a sanitary point of view, of the streets being well watered before the scavengers are allowed to commence operations; otherwise the light dust is only made to change its locality, and is not properly removed. It is not pleasant to contemplate the possibility of germs of disease being wafted along with this decaying matter and inhaled by those whose condition might be favourable for its development. The author hopes to bring the details of these observations before the Society at some future time.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

February 1st, 1869.

J. B. DANCER, F.R.A.S., President of the Section, in the Chair.

Mr. JOHN BARROW read the following note "*On a Comparative Analysis of English and Aleppo Galls.*"

When Mr. Sidebotham brought before the notice of this Section the subject of the large increase in the production of galls upon the oaks in this country, he expressed a wish that some member would make an analysis of them so as to confirm his experiments as to their value.

I requested Mr. Watson Smith, F.C.S., who is at present engaged in my laboratory, to undertake this task, and have pleasure in submitting to the Section his results. In order to make the analysis of practical value I suggested to him that he should examine both the English and Aleppo galls, and he has therefore experimented on the best sample of Aleppo galls I could procure and English galls obtained fresh from Cheshire.

The process used in both cases was that of Pelouze, viz., by crushing with ether; and, although this process is not absolutely accurate, it is the best one that Mr. Smith or myself could discover.

The results are—

	Aleppo Galls.	English Galls.
Gallo-tannic acid	61·65	26·71
Gallic acid	1·60	.. trace only
Woody fibre	15·68	47·88
Water	12·32	20·61
Colouring matter and loss ..	8·75	4·80
	100·00	100·00

Probably more gallic acid would be found if the galls had been gathered a longer time.

This analysis confirms Mr. Sidebotham's opinion of the value of the English galls, but does not make them quite as valuable as he puts them.

NEWCASTLE CHEMICAL SOCIETY.

THE third general meeting was held on Feb. 24th, Mr. GLOVER, in the Chair.

Dr. SCHWARZ read a paper "*On the Toxicology of the Cyanides.*" On the motion of the Chairman a vote of thanks was awarded to him.

Dr. LUNGE read, for Dr. CLEMM, a description of "*A New Volumetric Process for Sulphuric Acid and Sulphates.*" The method, which is of course incompatible with the presence of certain radicles, may be summed up thus:—Accurately neutralise, precipitate by excess of standard $BaCl_2$, then add excess of standard Na_2CO_3, make up to, say, 200 c.c., filter off 100 c.c., and litrate the unremoved carbonate.

Dr. LUNGE described at some length the modifications necessary in the case of pyrites, and cited test analyses which had given quite satisfactory results.

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

A meeting was held in the Society's rooms, Andersonian Buildings, on Monday, the 1st inst, at eight o'clock in the evening, Dr. W. Wallace in the Chair.

One member was balloted for and declared duly admitted, and two candidates were proposed.

A lecture was delivered by A. S. HERSCHEL, Esq., B.A., F.R.A.S, "*On the Methods and Recent Progress of Spectrum Analysis.*" We shall give this lecture, either in full or in abstract, in as early a number as possible.

FOREIGN SCIENCE.

PARIS, MARCH 3, 1869.

Action of Iodine on Sulphides.—Alloys of Copper and Tin.—Union of Free Nitrogen and Acetylene and Direct Synthesis of Hydrocyanic Acid.

MM. FILHOL and MELLIER have published a research upon the action which iodine exerts upon various sulphides. The action which iodine exerts on alkaline sulphides is already known; it consists in the displacement of the sulphur by iodine: the manner in which iodine acts upon insoluble sulphides is, however, but imperfectly known. Both natural and artificial sulphides were operated upon, and iodine was brought in contact with these bodies, sometimes in a dry state, and at others in solution in alcohol, ether, sulphide of carbon, chloroform, &c. The action is generally rapid in the case of artificially prepared sulphides, in the form of precipitates; it is sometimes accompanied by great heat, reducing a portion of

the iodine to vapour. For this reason, it would probably be dangerous to mix sulphides and iodine dry, or in any quantity. Natural sulphides are attacked more slowly, but the elevation of temperature is observable in certain cases. The same effect is produced when iodine in a solution of iodide of potassium is made to act upon the sulphide. In certain cases, the reaction is complicated by the presence of the solvent and the easy decomposition of the iodide.

In a note communicated to the Academy by M. Riche, the following facts concerning the alloys of copper and tin are given. The question of density is first taken. Some determinations were made upon bars of these metals, weighing from 50 to 60 grms., but the results obtained were unimportant, owing to the great difference which exists in these alloys. The same metals, reduced to fine powder, were afterwards operated upon, when it was observed that the contraction increases very regularly from the very rich alloy in tin to the mixture $SnCu_2$, and from this point it increases suddenly, arriving at a maximum, when the copper and tin are united in the relation of 1 to 3. The density diminishes from this point, then rises again nearly regularly; the density of the richest copper alloys is inferior to the mixture $SnCu_3$, which only contains 62 per cent of copper. Besides, this alloy may be distinguished from all the others by its properties; it is brittle enough to be pounded in a mortar, and forms crystals of a bluish tint, not resembling in the least either copper or tin. M. Riche gives a number of formulæ, expressing the composition of the definite compounds which copper forms with tin and their properties. Referring to liquefaction, he then observes, "In order to separate these alloys, the mass should be moved about when becoming solid, to separate the crystals whilst forming." The fusibility of these alloys has been determined by the thermo-electric pyrometer. M. Riche has operated comparatively with these alloys, and with metals whose fusing points have been settled by various experimenters. Numerous determinations show that the solidification of the alloys $SnCu_3$ and $SnCu_4$ takes place at a temperature somewhere between the fusion point of antimony and the boiling point of cadmium.

M. Balard has presented a note from M. Berthelot, in which the union of free nitrogen and acetylene, and the direct synthesis of hydrocyanic acid are explained. Free nitrogen is distinguished by its indifference to most other bodies; it is only when under the influence of the electric spark that this indifference can be successfully combated, either with oxygen, as in Cavendish's celebrated experience, or with hydrogen, which leaves traces of ammonia. A new reaction of the same class is now to be noted, namely, the direct union of free nitrogen with acetylene, in which case hydrocyanic acid is found. Acetylene is a hydrocarbon possessing remarkable chemical activity. Formed by the direct synthesis of the elements, it may afterwards be united with nascent or even free hydrogen to form olefiant or ethylene gas at first, and then hydride of ethylene; free acetylene may be combined directly with nascent oxygen to form oxalic acid. The metals of the alkalies attack it easily. This same chemical activity is also servable between acetylene and nitrogen in the free state. Thus, when a series of induction sparks is made to traverse a mixture of these two pure gases, the characteristic odour of hydrocyanic acid is soon perceived; the amount may also be estimated by the ordinary processes. In the circumstances just mentioned, the formation of hydrocyanic acid is accompanied by carbon and hydrogen, engendered by a distinct, but simultaneous, decomposition of acetylene. This complication may be avoided by adding to the mixture, beforehand, a sufficient volume of hydrogen, for example, ten times the volume of the acetylene: no deposit of carbon is then observed, and the reaction corresponds with the following equations:— $C_4H_2N_2=2C_2HN$. In other terms, the acetylene and nitrogen combine in equal volumes and without condensation. Cyanogen and hydrogen are combined in the same manner:—$C_4N_2+H_2=2C_2HN$. The formation of hydrocyanic acid in the reaction of nitrogen upon acetylene commences rather rapidly, but very soon slackens. In an experiment made upon 160 c.c. of a mixture formed of 10 volumes of acetylene, 14·5 nitrogen, and 75·5 hydrogen, after passing sparks for an hour and a half, 8 c.c. (10 milligrammes) of hydrocyanic acid were obtained without any deposit of carbon: when the action slackens it may be started afresh by removing the hydrocyanic acid by means of a moistened fragment of potash, and then exposing the purified gas to the influence of sparks. The action always ends by slackening, in consequence of the gradual dilution of the acetylene.

By following up the experiment, a certain volume of acetylene may be made to disappear by placing previously in the eprouvette a drop of a strong solution of potash, to absorb the hydrocyanic acid as fast as it is formed. In this manner 5-6ths of a known volume of acetylene may be changed into hydrocyanic acid. M. Berthelot explains the failure of the sixth part by the inevitable reaction of the vapour of water, which forms carbonic oxide and carbonic acid. This experiment required from twelve to fifteen hours' sparks. More than half of a known volume of nitrogen was changed into hydrocyanic acid in presence of an excess of acetylene; the rest would probably disappear after a much longer time. The presence of the hydrocyanic acid which is already formed, stops the reaction. This circumstance is easily explained. The mixture of hydrocyanic acid and hydrogen, traversed by a series of sparks, produces acetylene very quickly. Under the influence of the sparks, a certain variable equilibrium, according to the proportions, exists between hydrogen, nitrogen, acetylene, and hydrocyanic acid.

Pure nitrogen, under the prolonged influence of sparks, will not combine either with hydrogen or acetylene. Another interesting phenomenon occurs in the transformation of free nitrogen into hydrocyanic acid by union with acetylene. M. Berthelot states that all hydrocarbon compounds produce acetylene under the influence of sparks; thus it appears that nitrogen, mixed with whatsoever hydrocarbon vapour, should also form hydrocyanic acid. M. Berthelot has verified this fact with olefiant gas and with hydride of hexylene (from petroleum). In operating in presence of potash, Prussian blue is found among the products, after two or three minutes' sparks, an easy and sensitive test for nitrogen. M. Berthelot states in conclusion with reference to the chemical action of electricity that he has already observed that hydrocyanic acid is a body formed with absorption of heat from its elements, he now shows that hydrocyanic acid may also be produced by the direct union of carbide of hydrogen and nitrogen under the influence of the electric spark.

CORRESPONDENCE.

ON PHOSPHORUS IN IRON AND STEEL.

To the Editor of the Chemical News.

SIR,—I am sorry to see that Dr. Paul in replying to my letter on the above subject, has merely perpetrated a few common-place sarcasms, which cannot throw any light upon the chemical relations of phosphorus to iron, and which were certainly not called for by any remarks of mine.

That the fallacy I referred to does exist somewhere outside of my imagination, can be seen at once by reference to the CHEMICAL NEWS of Jan. 29th, p. 58. Anybody who refers to that report—the accuracy of which Dr. Paul does not question—will see that he commences with the statement that "It is generally considered that very small quantities of phosphorus in malleable iron and steel are most prejudicial to the quality of the metal,"

and that "quite recently an eminent metallurgist has stated, as a fact, that much less than 0·3 per cent of phosphorus produces a decided and injurious effect upon steel." He then proceeds to controvert that statement, and bases his controversion on the fact that "he had recently had an opportunity of testing the truth of this conclusion by determining the phosphorus in some samples of iron and steel," &c. He then states *how* the quality of these seven bars of iron and two bars of steel was tested—viz., by Mr. Kirkaldy's tensile strain and extension tests; he gives Mr. Kirkaldy's figures, and those of his own analyses, and finding that the iron and steel containing so much phosphorus stood these mechanical tests so satisfactorily, he "*therefore* thinks himself justified in asserting that the commonly-received opinion on this subject does not always represent the truth."

The object of my letter was to show that this reliance upon the gradually applied tenacity and extension tests is fallacious; that these tests, though of great practical value in determining some points, do not detect the special mischief which phosphorus, in small quantities, does to iron and steel. It was quite evident, from the discussion which followed the reading of Dr. Paul's paper in the Chemical Society, and from expressions of opinion recently made in other places, that Dr. Paul is not the only one who has been misled by the application of these tests, which, as I explained, may even represent all kinds of malleable iron, and some kinds of steel, as actually improved by the addition of a little phosphorus, on account of the increased tenacity of a peculiar kind which it confers.

When I referred to my own position as chemist to one of the largest and most important iron-works in Europe, it was not, as Dr. Paul insinuates, with the view of self-exaltation, but to indicate, that, in pointing out a mistake made by him and Dr. Miller, I was merely correcting a technical error, which any chemist, not having such daily and special "opportunities of comparing the results of chemical analysis with the verdicts of practical trials," would be liable to make.

I confined myself to a general statement of the facts (Dr. Paul seems to regard brittleness, tenacity, hardness, cold-shortness, &c., as only "opinions") best known concerning the special characters of the deterioration produced by phosphorus, simply because my letter had already made a sufficient demand both upon your columns and my time; but if the subject is considered sufficiently interesting, I shall be happy to take an early opportunity of supplying you with some illustrations of the special instances from which the general inductions are derived.—I am, &c.,

W. Mattieu Williams.

The Laboratory, Sir John Brown and Co., Sheffield.

[Our correspondent will confer a favour on our readers by communicating the valuable information he so kindly volunteers.—*Ed. C. N.*]

SPURIOUS GUANO.

To the Editor of the Chemical News.

Sir,—Dr. Paul, in your last impression, has a letter with the above heading, containing, as I think, a very unjustifiable attack upon the manufacturers of a manure called "Biphosphated Peruvian Guano." He says, "It is not Peruvian guano at all;" that "it more nearly resembles superphosphate of lime;" that "it is not worth one-half the price asked for it;" that "it contains not much more than one-third the quantity of ammonia in Peruvian guano," and that it is a trashy manure. Surely Dr. Paul cannot be very familiar with the subject on which he writes, when he ventures to make these statements? I have no desire to speak harshly of Dr. Paul, who may be acting under some misapprehension, or to question the propriety of admitting into your valuable journal a letter intended to be very damaging, without some inquiry, when at least a week must pass before any reply can be made, but, as I have been frequently consulted upon the subject of this manure and its manufacture, and have made repeated analyses of the products, I think it necessary to say a few words in answer to Dr. Paul. The works are freely open to me, and I have constant opportunities of watching every stage of the processes, but, whilst I have neither the right nor the inclination to disclose the methods adopted, I may say that they are perfectly simple and straightforward; there is no mystery either in the name or in the composition, the former pretty nearly indicating the latter; and in reference to its composition, it does actually contain more than 50 per cent of fine Peruvian Government guano; more than 24 per cent of phosphate of lime, of which 21 per cent, at least, is soluble; 6 per cent of alkaline salts; and 7 per cent of ammonia. Dr. Paul says there is no Peruvian guano at all, and that this is a "trashy manure." Dr. Voelcker, Dr. Anderson, Professor Way, Mr. Sibson, and myself, differ with him on all points, and, as I cannot ask you to include their opinions at length in my letter, I beg to refer to your advertising columns for their analyses in detail, to their reports upon the value of the manure for all purposes.—I am, &c.,

G. H. Ogston.

22, Mincing Lane, E.C., March 2nd, 1869.

To the Editor of the Chemical News.

Sir,—With reference to a letter from Mr. B. H. Paul, which was contained in your last week's number, Mr. Ogston has informed us that he has thought it well to make some reply to Mr. B. H. Paul, and we will, therefore, only ask your readers' attention to the testimony borne to the value of this manure by the best authorities on agricultural chemistry, contained in their published analyses and reports, and inserted in your present number as an advertisment, itself an answer most complete to anything Mr. B. H. Paul may say.

We may add that we immediately commenced proceedings at law against Mr. B. H. Paul, for the statements contained in his letter.—We are, &c.,

Rees and Co.,

32, King William Street, E.C., March 2nd, 1869.

MISCELLANEOUS.

The Presidency of the Chemical Society.—At the meeting of this Society, held last evening, it was announced from the chair that Dr. Frankland, who had been nominated by the Council for election to the Presidency, had been compelled to decline that honour, owing to his present engagements rendering him unable to fulfil the duties. The subject is anxiously occupying the attention of the Council, and it is expected, before the next meeting, that a new balloting list for the election of Officers will be forwarded to the Members. The Council's list for the election of the other Members of Council stands as follows:— E. Atkinson, Ph.D., J. L. Bell, E. T. Chapman, W. Crookes, F.R.S., D. Forbes, F.R.S., D. Hanbury, F.R.S., A. Matthiessen, Ph.D., F.R.S., E. J. Mills, J. Prestwich, F.R.S., Maxwell Simpson, Ph.D., F.R.S., A. Voelcker, Ph.D., C. Greville Williams, F.R.S.

A New Element.—In our next number will be given a preliminary notice of a new element, discovered by means of spectrum analysis.

Gas Examiner for the City of London.—At a meeting of the Court of Common Council held on Thursday, Feb. 25th, the report of the Gas Examiner Committee was read, from which we learn that Mr. Heisch, F.C.S., and Dr. Whitmore are recommended as duly qualified for the office; and it is left for the Court to select one of these two well-known gentlemen. The report of the committee was carried almost unanimously.

How to Preserve Sodium Untarnished.—Many teachers, particularly in our high schools, have sodium preserved in the usual way, under naphtha. But the beautiful metallic lustre is not seen under these circumstances; and if the metal is taken out and a fresh cut made, this only shows the lustre for an instant. By the following artifice the metallic appearance of sodium may be permanently exhibited:—Take two test tubes, one a little smaller than the other, so as to slip into the latter without leaving much space between the two glass walls; put some carefully cleaned sodium in the wider tube, insert the more narrow tube, having previously given a thin coating of beeswax to the upper part of this latter, then gently heat the whole on a sand bath. The sodium will fuse, and by a gentle pressure, the inner tube is pressed down, so as to force the fused metal over a large surface between the two tubes, while the air is totally excluded by the beeswax. I have kept sodium for more than six months in this way, and it is now as bright and brilliant as when first put up.—*Prof. Gustavus Hinrichs, in the Scientific American.*

Discovery of the Weight of Air.—The following extracts from a letter addressed to us by the Abbé A. Hamy will be read with interest:—It has long been asserted that, before Galileo's experiment in 1643, the weight of air had not been demonstrated. However, many learned men, both of former times and of the present century, acknowledge that Aristotle attempted to demonstrate this important fact, while, at the same time, they are unanimous in declaring that the means employed by him were inadeqate to the end he wished to accomplish. The honour of this great discovery is now yielded incontestibly to Galileo, and what chance I shall stand of restoring the glory of it to the philosopher appears doubtful; but my conviction is, that he has a right to it, although his opinions on the nature of gravity differ from those of modern scientific men. In "De Cœlo," lib. 4, we read:—"Suo enim in loco, gravitatem habent omnia præter ignem. Signum cujus est, utrem inflatum plus ponderis quam vacuum habere." "In their own medium, all bodies except heat, have weight; the proof of which is, that a leathern bottle weighs more when filled with air than it does when empty." It was, I believe, on this experiment that Aristotle founded his assertion of the gravity of air; and the only ground on which men of science based their opinion that the merit of the discovery was not due to him was, that in endeavouring themselves to test the truth of this assertion, many of them failed to detect any difference in weight between a bladder filled with air and one entirely empty. Such were the arguments used till the time of Galileo; then, by the exact measurement of the gravity of air, the failure of Aristotle's experiment could be accounted for; and, during the present century, in all elementary books in which the barometer is mentioned the vain attempt of Aristotle to measure the real weight of air is also spoken of. But it appears to me, that the arguments used by the philosopher's enemies fail to prove what they really intend. Of course they are right if they can demonstrate that he experimented with air at the same pressure as that of the atmosphere. But what grounds have they for such an opinion? Is it that they attribute to Aristotle what are, in reality, the failures aud mistakes of his followers? We have, on the one side, the clear assertion that all bodies except heat, possess weight; and, on the other, Aristotle furnishes us with a process for the verification of this statement, which consists in weighing, not an extensible bladder, but an almost inextensible leathern jar successively full and empty of air. Now what conclusion are we to arrive at from such premises? That it is impossible to succeed? Or might it not be more correct to say, that by a process the details of which have not been transmitted to us, Aristotle himself succeeded in proving the gravity of air, while the attempts of his followers to do the same resulted in failure? For myself, I believe that the great philosopher, by means of a blowpipe, confined in his leathern jar more air than it would contain at the normal pressure; and, after weighing it, first empty and then full, he found such a difference that he could positively assert the gravity of air. In these days, when *á priori* arguments are so decried, we may be allowed to dissent from a similar reasoning which would rob antiquity of its glories. Therefore, instead of saying, "Although Aristotle stated that air was heavy, he tested it by a wrong process, which tended rather to prove the contrary," it would be more just to say, "Although Aristotle made use of a process which, at first sight, appears a wrong one, yet, as we find that by the supposition of compressed air he might succeed, we conclude that he discovered the truth, since it was he who asserted the fact.

NOTES AND QUERIES.

Substitute for White Lead.—Mr. Sace has called attention to the fact that tungstate of baryta forms an excellent white paint, which has as good a tone and depth as white lead, and has the advantage above this of not becoming blackened on exposure to the atmosphere. Zinc-white, which was tried as a substitute for white lead, has failed through wanting body.

Pigment Colours.—Among the very small number of books published on the subject of the manufacture of pigment colours the most recent is that edited by J. G. Gentele, published at Brunswick, by Vieweg and Son, under the title, "Lehrbuch der Farben Fabrikation; &c.," 1860, or later. This is a most useful and complete treatise on this subject, and full of sound practical information.

Removing Carbonic Acid Gas from Wells.—A correspondent of the *Scientific American* gives an account of an ingeniously extemporised apparatus for removing carbonic acid from wells. It was simply an opened out and extended umbrella let down and rapidly hauled up a number of times in succession. The effect was to remove the gas in a few minutes from a well so foul as to instantly extinguish a candle previous to the use of the umbrella.

Coal Ashes.—A series of experiments conducted at the Museum of Natural History, Paris, during the past year by Professor Nsudin, has resulted in the conclusion that coal ashes act neither as manure nor even as earth of the most infertile quality. It is certain, however, that upon a heavy clay they act as disintegrators, an effect which cannot very well be only mechanical, as a very small amount of coal ashes is sufficient to destroy the adhesiveness of a large amount of clay.—*Engineer.*

Products of an Alkali Work.—What is the yellow colouring matter in good strong sulphate of soda? What is the red colouring matter in red balls? What is the red colouring matter in red liquor? What is the red colouring matter in ordinary soda ash? In making a full analysis of soda ash ought the soda which is combined with the silica to be deducted from the total available soda? or, in other words, is the total available soda affected by the presence of silicate of soda? —X.

Dyes from Ochella Weed: Orchella.—"Chromo" is referred to "Ure's Dictionary of Arts, Manufactures, and Mines," 6th edition. (articles: Litmus, Lichen, Orchella Weeds, Orcin); also to "Watts's Dictionary of Chemistry," vol. iv. (articles: Orcein, Orchil, and others); and, lastly, for a very full account on this matter to "Theorie und Praxis der Gewerbe. Hand und Lehrbuch der Technologie," von Dr. J. R. Wagner, vol. iv., page 470 and following. All these works may be inspected at the library of the Commissioners of Patents.

Alloy for Silver Coinage.—The authorities of the Mint of France have been experimenting for replacing copper either partially or entirely as an alloy for the silver coinage of that country. The advantages are said to be that the metal (alloy) is more homogeneous, has at least as fine a white lustre, and possesses a clear ring and considerable elasticity. When toughened by continued or repeated rolling it annealed by simple heating, it is less liable to be blackened by sulphuretted hydrogen. A mixture containing 835 parts of silver, 93 of copper and 72 of zinc is recommended.—*Engineer.*

Lute for Corks.—Professor Hirzel, of Leipzig, recommends as a lute for covering the corks of vessels containing volatile substances (as for instance, benzin, light petroleum oil, and essential oils), a mixture made up of finely ground litharge and concentrated glycerine; this is made into a paste, and the corks or bungs are covered with it; this mixture hardens very rapidly, is insoluble in, and not at all acted upon by, the said liquids, and is inexpensive, inasmuch as even coarse glycerine, provided it is concentrated, answers the purpose.—*Dingl. Polyt. Journal.*

Chemical Nomenclature.—It strikes me that the following rule would be desirable in chemical nomenclature, at least as to organic compounds:—That "oxide of" (or chloride, &c.) should always be used where oxygen is added to the body, and "oxide" (&c.) after the name when a substitution takes place only, thus:—The true constitution would be expressed by the name (say of CH_3I), whether called "iodide of methyl" or "methane iodide"; but it should never be called "methyl iodide," to avoid confusion. So far as supposed radicals do not exist, unless in composition, attention to this rule would do away with an unnecessary assumptiou, and make the names more expressive of actual knowledge.—H. H.

Glycerine: its Uses and Abuses.—Tubs and pails saturated with glycerine will not shrink and dry up, the hoops will not fall off, and there will be no necessity for keeping these articles soaked. Butter-tubs keep fresh and sweet, and can be used a second time. Leather treated with it also remains moist, and is not liable to crack and break. It is used for the extraction of perfume from rose leaves and other scented materials; employed to preserve animal substances from decay, and therefore also to prevent many articles of food from undergoing decomposition; mixed with its own bulk of water it is used in gas-meters, owing to its requiring intense cold to freeze; the works of delicate chronometers, clocks, and watches are lubricated with it. It is largely used in pharmacy to keep moist and preserve extracts, pills, and other preparations; it is used in dyeing some of our beautiful organic colours; in chemistry it is applied to prevent the precipitation of the heavy metals by the alkalies, and is thus a reagent in analysis; it is used in brewing beer for making an extract of malt, as also in the manufacture of liqueurs (cordials); it is applied to the preservation, and no doubt to more than that, viz., the making of wines and champagne. Since glycerine can be fermented into alcohol with chalk and cheese, it may in future become a source of alcohol and acetic acid. Lastly, glycerine is the source of nitroglycerine, a most dangerously explosive substance, and of dynamite, which is simply nitroglycerine mixed with sand, and is much less dangerous than nitroglycerine, and nearly as destructive in its effects, as it contains 76 per cent of nitroglycerine.—*Abbreviated from the Scientific American.*

Swiss Concentrated Milk.—Results of analyses of concentrated milk, so-called extract of milk, prepared at Cham, near Zug, Switzerland. According to Dr. Bolley, 100 parts of the concentrated substance contain:—

Butter (fatty matter)	8·67
Caseine and lacto-proteine	13·67
Sugar of milk	10·82
Cane sugar (added previous to beginning the operation of concentration)	40·48
Mineral matter..	2·23
Water	24·13
	100·00

If we deduct the quantity of water and that of the cane sugar, there remains 35·39 per cent for the constituents of really dry milk. Since the dry matter of good cow's milk contains, according to an average of four analyses made at Cham by Dr. Bolley,

Butter (fatty matter)..	3·95
Proteine substances	4·30
Sugar of milk	4·60
Mineral matter	0·72

it follows that 261 grammes of this milk contain as much dry solid matter as 100 grammes of the concentrated milk.—*Abstracted from Gewerbeblatt, &c., für Bayern.*

MEETINGS FOR THE WEEK.

MONDAY, March 8th.—Royal Geographical, 8½.
—— Medical, 5. Anniversary Oration.
—— London Institution, 6.
TUESDAY, 9th.—Royal Institution, 3. Rev. F. W. Farrar, "On Comparative Philology."
—— Photographic, 8
WEDNESDAY, 10th.—Society of Arts, 8.
—— Geological, 8.
—— Microscopical, 8.
THURSDAY, 11th.—Royal Institution, 3. Dr. H. Power, "On the Eye."
—— Royal, 8½.
—— Zoological, 8½.
—— Royal Society Club, 6.
FRIDAY, 12th.—Royal Institution, 8. Professor Abel, "On Naval and Military Applications of Electricity."
—— Astronomical, 8.
SATURDAY, 13th.—Royal Institution, 3. Dr. Odling, "On Hydrogen and its Analogues."

TO CORRESPONDENTS.

S. C. C.—We will make enquiries.

Soap-Tablet Stamping Machine—A Subscriber who enquired for the above is informed that Messrs. W. Neill and Son, Engineers, Bold, St. Helen's Junction, manufacture a patent steam-power soap tablet stamping machine.

Refiner.—It has already been recorded that the heat of steam will ignite some readily combustible substances, especially after they have become very dry. This is so well known in sugar works that steam pipes, whenever they come near wood work, are always enveloped with sheet lead, felt, and a wooden case containing ashes, peat-ash in preference. Serious fires have been occasioned in oil and paper mills by steam heat.

Communications have been received from Professor Gustavus Hinrichs, Iowa (with enclosures); the Quekett Microscopical Society; Professor Brazier; G. Blogg; J. Berger Spence; Dr. R. Angus Smith, F.R.S.; J. H. Pepper; C. Heisch; R. Murray; Rees and Co.; G. H. Ogston; W. Mackenzie; W. M. Williams; F. C. Calvert and Co.; T. Hill; W. H. Harris (with enclosure); J. Muspratt and Sons; Dr. Andrews (with enclosure); Muspratt Brothers and Huntley; G. F. Glover (with enclosure), and Dr. Röhrig.

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THE CHEMICAL NEWS.

Vol. XIX. No. 484.

A NEW ELEMENT ACCOMPANYING ZIRCONIUM,

DISCOVERED BY MEANS OF

SPECTRUM ANALYSIS.

At the *soirés* of the Royal Society, on Saturday last, March 6th, Mr. H. C. Sorby, F.R.S., exhibited for the first time some phenomena in his spectrum microscope, which have led him to the conclusion that they are due to the presence of a new element, for which he has proposed the name of jargonium. The following is the account which Mr. Sorby then gave of this discovery:—

"Jargonia is an earth closely allied to zirconia, existing in small quantity in zircons from various localities, but constituting the chief ingredient of some of the jargons from Ceylon. It is, however, distinguished from zirconia and all other known elementary substances by the following very remarkable properties. The natural silicate is almost, if not quite colourless, and yet it gives a spectrum which shows above a dozen narrow black lines, much more distinct than even those characteristic of salts of didymium. When melted with borax it gives a glassy bead, clear and colourless both hot and cold, and no trace of absorption bands can be seen in the spectrum; but if the borax bead be saturated at a high temperature, and flamed, so that it may be filled with crystals of borate of jargonia, the spectrum shows four distinct absorption bands, unlike those due to any other known substance."

It appears however, by the following communication from Professor A. H. Church, M.A., that a similar, if not identically the same, discovery was published nearly three years ago. Professor Church writes as follows:—

"Royal Agricultural College,
"March 6, 1869.

"I heard, when in London this week, that Mr. Sorby had discovered a set of black absorption bands in certain zircons, and had attributed their occurrence to the presence in the stones examined of a new element accompanying the zirconium. May I be permitted to refer your readers to the woodcut of these bands, which I published three years ago in the *Intellectual Observer* for May, 1866? The sketch was rough, and the cut badly executed, but it shows, though without the delicate shading of the original bands, the effect on solar light of its passage through a considerable thickness of a particular Ceylon zircon, or jargoon, in my possession. Not only did I describe the bands, but I noticed their occurrence in the spectra of some stones from particular localities (Ceylon), and their absence from stones from other localities (Espailly). I also added my views as to the cause of these bands—the presence of an element in some specimens, not found in others. I quote one or two sentences from the note referred to above:—'I am induced to hazard the conjecture that it may be, after all, Svanberg's *norium*, which determines the difference.' 'The absorption bands of zircon resemble those of didymium discovered by Gladstone, in their sharpness, and in their being produced by the passage of light through a colourless medium.'

"Since 1866, I have worked at intervals on the subject of the supposed norium. The rarity and costliness of the best and purest materials for the research—viz., transparent and flawless, and nearly colourless specimens—have seriously retarded the progress of my research. I have nothing ready for publication, but simply note the following points, which I have established with more or less certainty since the first conjecture which I made of an element different from zirconium in the 'black-banded' jargoons:—

"1. That zirconium is accompanied by at least one other metal (probably by two), in some of the zircons from Indian, American, and Norwegian localities.

"2. That the seven black absorption bands discovered in 1866 are characteristic of this new element, in some of its combinations at least, although I have not traced them definitely in any solution as yet.

"3. That the atomic weight of one of the new accompanying elements is different from that of zirconium.

"4. That the density of those zircons which show the black bands most intensely in the smallest thickness, is lower than that of those zircons which show no bands or only very faint bands. (In 1866, I showed that neither the direction in which the light was transmitted through the crystal, nor the action of an intense ignition, had any apparent influence on the particular absorptive power of zircons for light now under discussion). Of course the comparison must be made with specimens in their native state and without flaws, or with specimens which have been similarly ignited, by which process the density is increased.

"5. The characteristic salts obtained from the black-band zircons may prove to have been included under those of norium by Svanberg. But, as that term does not exclude some bodies which are certainly different from those which seem to belong only to the black-band zircons, a new name may have to be coined. *Nigrium* suggests itself as at once appropriate and consistent with the received system of nomenclature.

"I may add that the black bands were shown or described at the time of their discovery to many of my friends, among whom I may name Dr. Gladstone, Mr. Slack, and Mr. John Browning.

"Some of the zircons employed in my experiments are described in the *Chemical Society's Journal* for 1864 (November and December). The best was of a very pale greenish hue and without a flaw. It weighed 1·1665 grammes, and its density before ignition was 4·579, after 4·625. A rather smaller Espailly specimen was orange-red before ignition, and had a density of 4·863. After ignition it became colourless, but its density remained the same. In neither state did it exhibit any black bands, nor have I obtained from several ounces of the zircon from this locality any other salts than those of zirconia."

Professor Church has forwarded the original drawing of the bands, torn out of his note-book. From this the following woodcut has been engraved.

It appears only fair both to Professor Church and Mr. Sorby, that the original article in the *Intellectual Observer* for May, 1866, should be given together with the above more recent notes. We therefore reprint it as follows:—

"Micro-Spectroscope Investigations.

"*Letter from Professor Church.*

"The Editor has received the following interesting letter from Professor Church:—

"'Have you tried the experiment with chloride of cobalt, which I mentioned to you? If you take the saturated cold solution of this salt it will give the spectrum roughly sketched in Fig. 1,* a *thinner* film of the *same* solution, heated (on a glass slide with thin cover) over the candle or lamp gives the spectrum drawn in Fig. 2.† You will

* "The figure alluded to shows the red darkened, the orange light, and a broad dark band commencing to the right of the yellow and extending beyond the line F; the remainder of the spectrum is cloudy."

† "Fig. 2 shows the narrow black bands in the red, modified tints replacing the broad dark band of Fig. 1, the blue coming out clear. The experiment is a very beautiful one."

notice two black bands, I had almost said lines, in the red. As might be predicted from the change of colour on heating, the solution is afterwards much more transparent to rays beyond D. The chlorides of copper and nickel also give very interesting results.

"But I think you will be most pleased with the experiment I have now to relate. I have worked lately on the spectra of pleochroic minerals and salts. Among the minerals recently examined were several fine specimens of the true zircon or jargoon, a silicate of zirconia. These gave a beautiful and most characteristic system of seven dark bands quite different from those belonging to any other substance yet examined. They are roughly sketched in the following figure.* Zircons as colourless as common glass show these bands as well, perhaps better, than those possessed of colour. They are to be observed with zircons which have been ignited, as well as with those still in their natural condition. But some zircons show the phenomenon better than others, this difference not being due apparently to the colour of the stone or the thickness through which the light traverses. I am not quite sure, but I incline to think that those zircons which have come from some localities show the bands better than those from others. Several Espailly specimens scarcely exhibit anything of this kind; all those from Ceylon and Norway show the bands well. From this observation I am induced to hazard the conjecture that it may be, after all, the presence of Svanberg's *norium* which determines the difference. You are aware that the orange jacinth, a variety of zircon, is very precious, and that the essonite, or cinnamon-garnet, is constantly sold for it. Curiously enough, the cinnamon-garnet, or essonite (a lime-garnet), has no conspicuous dark absorption bands at all, and so the spectroscope may be brought to bear upon the discrimination of these two stones. We have thus a much more ready process than that of taking the density of the specimens. The lime-garnet is of comparatively small value. The iron-garnet of different shades (carbuncle, almondine, &c.) gives a beautiful and very characteristic spectrum with several intensely deep absorption bands.

"'I write these particulars of my experiments at once, for I thought you might like to make a little paragraph about them for the readers of the *Intellectual Observer*.

"'I ought to add that the absorption bands of zircon resemble those of didymium, discovered by Gladstone, in their sharpness and in their being produced by the passage of light through a colourless medium. Silica, the other constituent of zircon, gives no bands.'"

The first who appears to have published researches on this subject is Svanberg. From his experiments he came to the conclusion that zirconia was not a simple earth, but a mixture of three, or perhaps even a greater number, of metallic oxides; and that these oxides are present in different proportions in the zircons obtained from different localities (*e.g.*, Siberia, Norway, and Ceylon), and in the hyacinth from Espailly in France. The atomic weight of these earths (supposing them to be sesqui-oxides) varies between 75 and 105·6, the mean of which, 91·2, is the atomic weight assigned by Berzelius to zirconia regarded as a simple earth. Svanberg could not succeed in completely separating these earths; but he found—1st. That the oxalate of one of them is less soluble in acids than the oxalates of the rest. 2nd. That the chloride of the radical of one of the earths is less easily soluble in hydrochloric acid than the corresponding compounds of the other radicals. 3rd. That the sulphate of one of them, when mixed with a large quantity of free sulphuric acid, crystallises much more easily than the sulphates of the rest, and likewise in a peculiar form. To the earth thus distinguished from the others with which it is associated, Svanberg gave the name of noria. This earth is likewise found in zircons from the Ilmenge-

* The diagram referred to is substantially the same as the copy from Professor Church's drawing printed on the previous page.

berg. In the eudialyte from Greenland, Svanberg thought he had discovered (besides cerium, lanthanum, and didymium) two other earths, the first of which closely resembles yttria; the second has a yellow colour. According to Watts's "Dictionary," article "Norium," a subsequent experimenter, Berlin, throws doubts upon the composite nature of the earth commonly called zirconia. Now that attention is again directed to this subject, it is to be hoped that these doubtful points will be cleared up. There seems no lack of new elements waiting to be discovered, and further researches may show that Svanberg's noria, Church's nigria, and Sorby's jargonia, are each separate entities.

Since the above was in type, we have received the following commmunication from Mr. Sorby:—

"36, Oxford Terrace, London, W.
"March 8, 1869.

"I send you an account of some of the objects I exhibited at the *soirée* of the Royal Society on Saturday, March 6th, illustrating the substance which gives such a remarkable spectrum.

"The specimen I showed was part of a jargon belonging to my friend, Mr. William Bragge, of Sheffield, who most kindly and liberally gave it to me for study. I soon found that the spectrum was not due to zirconia, since the zircons from some localities give no bands whatever: those from other localities show traces of the bands, as if they contained a small variable amount of the substance in question, mixed with zirconia, in the same manner that many are variously coloured with small quantities of the oxides of iron. If the borax blowpipe bead of this substance had given absorption bands, in the same manner as the oxides of didymium, erbium, cobalt, and uranium, there would have been no difficulty in proving whether or no it was a new elementary body; but when melted with borax it gave a clear, colourless bead, when both hot and cold, without any trace of absorption bands. Very many known oxides give such beads, and the question was whether any of these would give the remarkable absorption bands when they were in a crystalline state.

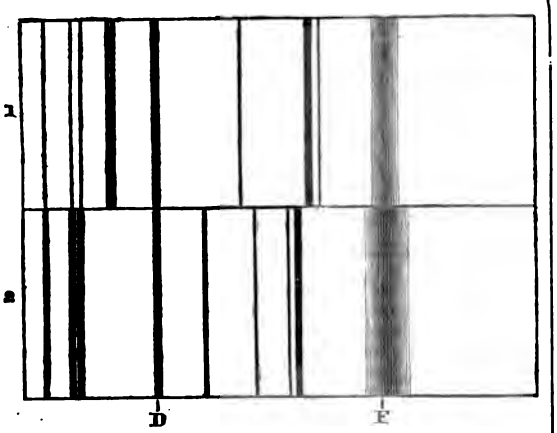
"There was no difficulty in proving that the crystalline silicates of a number of known earths and metallic oxides do not give any bands, but still a number of elementary substances could not be procured in combination with silica, or not in crystals sufficiently transparent to enable me to ascertain the fact for certain, though I prepared a large series of sections for this especial purpose. It was therefore open to doubt whether the substance which gave the bands was a new one or not, though I proved by my new blowpipe method that it was very closely allied to zirconia.

"At length it occurred to me that perhaps the production of the absorption bands depended on the substance being in a *crystalline* state, and I therefore saturated a borax blowpipe bead with it, and by flaming caused it to become full of minute crystals of the borate, so as to be white and almost opaque. By using a strong illumination, I succeeded in causing light to pass through the bead, and found that the spectrum then showed four absorption bands, very well marked, considering the nature of the case. None of these bands corresponded exactly with those of the silicate, and when microcosmic salt was added, so as to give rise to crystals of the phosphate, a spectrum was obtained with bands differing from both the others. The fact of the clear borax bead showing no bands until it is filled with crystals is, in my opinion, the most important yet discovered in connection with the subject, for it enables us to prove that the substance which gives the bands is no known earth or metallic oxide. Since it, therefore, appeared to be a new substance, and was found in certain specimens of the *jargon*, I thought no better name could be adopted than that of *jargonia*.

"This was the state of my knowledge of the subject when I came to London a few weeks ago, bringing with me the printed description of most of these facts, to give away at the *soirée* of the Royal Society. My attention

was subsequently called to Professor Church's letter in the *Intellectual Observer* for 1866, p. 291, which I had not previously heard of, since that work is almost unknown in the northern provinces. Judging from his description and figure, there can be no doubt that he had observed the spectrum of the same substance, only comparatively in a very imperfect manner, as will be seen by comparing his figure with that copied from my own drawing, shown at the Royal Society. He speaks of 'seven dark bands,' whereas my specimen shows double that number, He also says that 'all those from Ceylon and Norway show the bands well.' Now after having examined several hundred jargons from Ceylon, I must say that, in comparison with my own specimen, scarcely any show the bands *well*. There is not one single specimen in the British Museum that shows them even moderately well. One in the Museum of Practical Geology shows them in a very satisfactory manner, and I have seen two or three others that show them, though not anything like so well as my own, the exact locality of which must be considered to be still unknown for certain. Those from Norway show the bands in the same comparatively imperfect manner as the usual specimens from Ceylon, and, even assuming that my specimen contains but little zirconia, we must conclude that the zircons from both those localities contain only a small amount of the substance for which I have proposed the name *jargonia*. If any one had only seen the usual kind of specimens from Ceylon or Norway, I can easily believe that he might have been led to conclude, with Professor Church, that the production of the bands might depend on the presence of Svanberg's *noria*. However, since the zircons from Norway (Frederikswarn), which, according to Svanberg, are so rich in his noria that it materially modifies the chemical equivalent of the earth and the specific gravity of the mineral, are, according to my own spectroscopic observations, so very poor in my jargonia that they give only a very faint trace of the bands, I cannot admit that they are the same substance. My friend, Mr. David Forbes, has most kindly allowed me to examine the zircons from many localities in Norway, collected by himself; and given me a number to cut for examination; and I find that none contain more than a decided trace of my jargonia.

"My own specimen of jargon is so rich in jargonia that a piece one-tenth of an inch in thickness, and all but colourless, gives fourteen bands, as shown in the accompanying figure. Unlike most other absorption bands, thirteen



of these are narrow and perfectly black lines, surpassing in this respect even those characteristic of salts of didymium. When the section is cut parallel to the axis of the crystal, though it is almost colourless with ordinary light, it is slightly dichroic, giving a reddish and greenish image. The reason of this is easily understood when the spectrum is examined with a double image prism, so as to give two spectra side by side with the light polarised in opposite planes, as shown in the accompanying figure. The image in which the light is polarised in a plane parallel to the axis of the crystal (No. 1) shows a well marked double band in the red which is absent from the other image (No. 2), whilst that shows a band in the yellow part of the green which is absent in the other. There is also a difference in the position of several of the bands, and a difference in the intensity of others, whereas that in the yellow is nearly the same in both. These are remarkable peculiarities, since in most dichroic substances there is merely a difference in the intensity of all the bands.

"On the whole, therefore, it seems to me that these very striking absorption *lines* are due to an elementary substance not hitherto recognised, which can crystallise in all proportions as a silicate along with zirconia, and whose action on the spectrum varies to an unusual extent, according as it is in a vitreous state or crystallised in combination with different acids."

NOTE ON ARISTOTLE AND THE DISCOVERY OF THE WEIGHT OF THE AIR.

By G. F. RODWELL, F.C.S.

In the last number of this journal, M. l'Abbé Hamy has endeavoured to prove that, "before Galileo's experiment in 1643," the weight of air had been demonstrated by Aristotle. I alluded, in the CHEMICAL NEWS for Sept. 5, 1863,* to the passage in Aristotle's treatise, Περι Ουρανου, to which M. Hamy refers, and there stated that, as the experiment was made by weighing a bladder of air in air, the increase in weight before and after inflation undoubtedly arose from the aqueous vapour introduced by blowing into the bladder. I still incline to this opinion, and I have no hesitation in saying that there is no reliable evidence to make it even probable that Aristotle discovered the weight of air

I am at a loss to imagine to what M. Hamy refers in the phrase, "before Galileo's experiment in 1643;" first, because Galileo died in 1642; and, secondly, because the experiment in which he demonstrated, by direct weighing, that the air has weight, was made some years before his death; or, again, as to whether he refers to the Torricellian experiment, which was made in 1643.

M. Hamy bases his assertion on the following passage from Aristotle:—"Suo enim in loco gravitatem habent omnia præter ignem. Signum cujus est utrem inflatum plus ponderis quam vacuum habere." It is much to be regretted that he does not give the original text; but supposing the Latin translation to be correct, let us examine the statements. I am quite willing to cede the word *bladder* and to substitute for it *leather bag* or *bottle*, which *utrem* rightly signifies, if, as I suppose, the word in the original is ασκος; but I would remind M. Hamy that Ptolemy the mathematician, who repeated the experiment, employed a bladder, as also did Simplicius, one of the most exact and careful of the many commentators of Aristotle. I have invariably seen the word rendered *bladder*, both by ancient and modern commentators. The verification of the statement that all bodies possess weight except fire, is furnished, says M. Hamy, by the experiment of Aristotle, "which consists in weighing, not an extensible bladder, but an almost inextensible leathern jar, successively full and empty of air." Now, by what possible means *utrem inflatum* can be rendered *an almost inextensible leathern jar* I am at a loss to conceive. It is *inflatum*, hence it can exist in a state of non-inflation or the one word would not be required to qualify the other; neither could a leather jar full of air (which, if *almost in-*

* "On the Supposed Nature of Air Prior to the Discovery of Oxygen."

extensible, it must be at the commencement of the experiment) be called *vacuum*, and the same, with more air blown into it, *inflatum*. This is the very perversion of accurate diction, and of sound Latinity. *Inflatum* and *vacuum* are evidently here used antithetically,—an inflated condition opposed to a non-inflated condition; full opposed to empty. It seems to me that a tight seamless bladder capable of withstanding some internal pressure, and of being readily closed by tying, would suit M. Hamy's purpose much better than "an almost inextensible leathern jar," if he be bent upon showing that Aristotle discovered the weight of air. A leather bottle may contain a liquid, but what can be less adapted to contain a gas under pressure? M. Hamy would have it filled by a blowpipe; by which means he believes that Aristotle "confined in his leathern jar more air than it would normally contain," and then weighed it. Granting that the leather jar would stand pressure without leaking, let M. Hamy take the maximum pressure at which air can be forced from the lungs, and then calculate the quantity of air which could be thus condensed into a vessel, and the volume of that air requisite to give weight recognisable by a rough statera, and he will see the impracticability of the experiment.

According to M. Hamy, scientific men have not given the glory of the discovery to Aristotle "because in endeavouring themselves to test the truth of the assertion, many of them failed to detect any difference in weight between a bladder filled with air and one entirely empty." Let us hope many of them did fail; those who did not must have made an exceedingly gross error. Archimedes had proved that a body immersed in a liquid loses a portion of its weight equal to the weight of the liquid which it displaces, and this theorem applies here; since in the case of a bladder of air weighed in air, the air in the bladder loses *à priori* a weight equal to its own weight, it is clear that the bladder must weigh the same whether it be inflated or the reverse, and that the air weighs nothing in its own medium.

I can imagine how the demonstration of the weight of air was made by the philosopher who cared so little for the discovery of new truths. He is in the groves of the Lyceum in early morning, surrounded by pupils who are being instructed in acroamatics; he holds in his hand a leather bottle recently emptied of its Chian wine, or, perchance, the flaccid bladder of a Thracian bull, and, after a good deal of blowing, it is inflated and closed, Theophrastus, perhaps, acting as assistant (for he showed some taste for physics in after life). Then the inflated bladder is hung upon a clumsy statera, turning, perhaps, with the weight of half an Attic drachma, and the experiment is finished. But the students are not edified; they think it derogatory to study Nature, and one by one they wonder what their grandfather the Socratic would say to it all, or their father, who had sat at the feet of Plato.

We who deny that Aristotle discovered the weight of air are not "the philosopher's enemies," for this discovery would be almost a vanishing quantity when we consider how much he effected in other branches of knowledge; nor do we "strive to rob antiquity of its glories," for this discovery would add but little to an infinitely glorious past. Aristotle did not pretend to be an experimental philosopher; indeed, we question if he would thank M. Hamy for his disinterested attempt to make him one. Socrates and Seneca would have received such an imputation as an insult; the latter would have said (judging from some of his arguments in the "*De Vitâ Beata*")—"What matters it to me that the air has weight, I cannot alter it; let me rather strive to give weight to the actions of my life, and to leave a something which shall sink through all humanity." But, supposing that the discovery of the weight of the air had been made by Aristotle, we should not regard him as one whit the wiser man; it was not an age for the discovery of physical truths; the world was not ready for them; Pneumatics would not have become a science one year sooner, Otto Von Guericke would not have teamed his sixteen horses to the great hemispheres of Magdeburg one day the earlier.

It is, I think, a most injurious practice to foist upon antiquity by means of vague and hypothetical premises discoveries which belong to a later age; and the reverse of this, which more frequently occurs, is equally pernicious. The transference of the merit of a discovery should never be attempted except upon the surest and most absolute grounds, and in the presence of indestructible facts. I say here, with M. de Strada—"L'activité humaine, si puissante, si immense, si agissante, qu'elle soit dans la connaisance, ne trouve j'amais en elle-même la certitude, mais la trouve toujours dans et par le fait."*

NEW APPLICATIONS OF THE MICROSCOPE TO BLOWPIPE CHEMISTRY.

By H. C. SORBY, F.R.S.

Of these there are two chief divisions. In one method the substance is fused with borax or microcosmic salt, so as to give a clear bead, and the spectrum is examined by means of the spectrum eye-piece. In the other method the saturated borax bead is kept hot over the lamp, so that crystals may be deposited in it. By using a microscope many elements may then be easily distinguished by the form of the crystals, which are often of extreme beauty. When, however, much mixed, or combined with silica or other acids, as in natural minerals, it is often requisite to add various reagents—as phosphate of soda, microcosmic salt, boric, tungstic, molybdic, and titanic acids. These give rise to characteristic crystalline deposits; and we may thus distinguish lime, magnesia, baryta, and strontia, even when combined with silica; and can detect magnesia when mixed with several times its weight of lime, in impure limestone, &c.

Examples of this method:—

1. *Sphene*, melted with borax, does not deposit crystals; but the addition of boric acid sets free the titanic acid, easily recognised by the form of the crystals. Diluting the bead with more borax, so as to retain the titanic acid in solution, phosphate of soda causes the deposit of crystals of phosphate of lime.

2. *Fergusonite*, from Greenland, shows the spectrum of didymium, and from Ytterby that of erbium. When fused with borax, it deposits crystals of columbic acid; and after diluting with borax to prevent this, the addition of phosphate of soda produces crystals of phosphate of yttria.

3. *Gadolinite* from Ytterby, melted with borax, gives a spectrum indicating the presence of didymium and erbium; and when kept hot, it deposits the characteristic crystals of borate of yttria.

Numerous illustrations of this application were exhibited at the *soirée* of the Royal Society on Saturday last.

Application of the Spectrum-Microscope to Mineralogy.—At the *soirée* of the Royal Society, on Saturday last, Mr. Sorby exhibited specimens illustrating the application of the spectrum-microscope to mineralogy. He showed that the following substances could be recognised in transparent minerals or blowpipe beads by means of the characteristic absorption bands seen in the spectra, even when they were much coloured by the oxides of iron, manganese, or nickel—viz., didymium, erbium (erbium of Bunsen; Delafontaine's terbium); uranium, cobalt, chromium, copper, manganese (when it occurs as permanganic acid), a new earth, for which the name *jargonia* is proposed, and another substance, perhaps also new, but not yet sufficiently studied.

* "Philosophie Méthodique."

ON THE

CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(ADAPTED TO A JUVENILE AUDITORY),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,

(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, ESQ., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE V.

GRAPHITE—DIAMOND—CARBONIC SULPHIDE.

Solution of charcoal in strongly-heated iron, to form easily fusible mass of cast-iron—Separation, from slowly-cooled cast-iron, of crystalline scales of graphite—Occurrence of graphite in nature as plumbago, or black-lead—Identity of graphite with charcoal, shown by formation of carbonic gas as the sole product of its burning—Its difficult combustibility in air, but ready combustibility in oxygen gas—Distinct chemical compounds of graphite—Production of graphite by strong ignition of the diamond—High relative weight and conductive resistance of diamond—Identity of diamond with graphite and charcoal, shown by formation of carbonic gas as the sole product of its burning—Combustion of diamond in oxygen gas—Liquefaction of carbonic gas by great pressure—Rapid vaporisation of liquefied carbonic gas, with great absorption of heat—Consequent freezing or solidification of residuary liquid—Slow vaporisation of solidified carbonic gas—Rapid vaporisation of solidified carbonic gas when wetted with ether—Great absorption of heat by the vaporisation, and consequent production of intense cold, sufficient to freeze mercury.

IN this lecture I have to bring before you some very important points in reference to carbon or charcoal. You will remember that carbonic gas is oxidised charcoal,—a compound of charcoal or carbon with oxygen. I want now to call your attention to some other compounds of this charcoal or carbon, and one of the most important is that which it forms with iron. If we take a piece of fine iron, such as is used for wire, we shall find that it is either free from carbon, or contains a very minute proportion—not more than one-tenth per cent. How do we know this? We know it because, when wire is burned, it scarcely yields any carbonic gas as a product of its burning, and therefore we conclude that the iron is almost free from carbon; but if we take the same iron and heat it strongly in contact with charcoal, we find, afterwards, that it has undergone a considerable change. It alters very much in its character; it no longer possesses anything like the toughness it formerly had; it is either very soft or very brittle, according to circumstances, but it has lost the toughness which characterised the piece of pure iron. It has, moreover, acquired this property, namely, that when it is burnt, either in air or in oxygen, it yields a very considerable amount of oxidised carbon, or oxide of carbon, or carbonic gas. It has taken up a considerable quantity of charcoal—a quantity which may occasionally amount to 5 or 6 per cent. It is often, however, 4 per cent of the iron, and we know that it has absorbed this carbon by the alteration in its properties, and more especially by the fact that, when burned, it yields burnt carbon as a product of combustion. Well, this substance which is so produced, differs very remarkably in another way from pure iron—it is readily fusible, whereas pure iron is very difficult indeed to melt, and requires special arrangements for its fusion. We find that this substance, which is obtained by causing wrought-iron to enter into combination with carbon or charcoal, is a tolerably fusible material, so that it may be used for taking the finest castings. It is no longer pure iron, but a chemical compound of iron and charcoal. Now, when this compound is allowed to melt and cool slowly, it presents a very curious appearance, being covered with a series of scales. Here is a sample lent me by Mr. Abel, and here is another still more remarkable in its character. When we pick out these scales and examine them, we find that they consist of nothing but carbon; and we ascertain this by the fact, that when burned, they only yield carbonic gas or burnt carbon; so that the carbon which at first went into the iron is separated from it in the form of these scales, and we find that these scales are identical with black-lead or plumbago; in other words, we have converted this ordinary carbon into a substance known as graphite, black-lead, or plumbago.

Now, for some of the properties of this black-lead. It is a crystalline substance, and consists of pure carbon; it yields nothing but carbonic gas upon being burned; it is met with in nature, being found in metalliferous rocks, in Cumberland more particularly, and it is also found in meteorites. Here is a very fine section of a meteorite; it is a piece of iron that has fallen to the surface of the earth—it has fallen at any rate from the skies, and how much further we will not speculate. When we cut a meteorite in halves and get a section of it, we find that a great part of it is composed of iron; but in addition to the iron, we can pick out pieces of this black-lead, or graphite, or plumbago, such as we can manufacture artificially, in the form of scales, from the compound of charcoal and iron. Here is a piece which has been extracted from a natural mineral. Now this graphite, when burned, yields carbonic gas,

* Reported verbatim, by permission of the Author, for this Journal.

which has the property of converting lime-water into chalk and water. If you look at my notes or syllabus of the lecture, you will find written, with regard to this graphite, "Its difficult combustibility in air, but ready combustibility in oxygen gas." Well, that is rather an understatement of the question; it is so little combustible that, for practical purposes, it may be considered incombustible. I have mentioned its "ready combustibility in oxygen," but even in oxygen graphite burns with very considerable difficulty, and some contrivances must be adopted to enable it to burn fairly. For this purpose I will take a specimen of this powdered plumbago, black-lead, or graphite, and introduce it into a tube, formed of a piece of platinum foil. I put a small quantity of the graphite into the tube, and now I will light it by means of a piece of ordinary charcoal or pastille. Having ignited the charcoal, I will allow a current of oxygen gas to pass on it, and when once the graphite takes fire, you will observe, I think, that it will burn with very considerable brilliancy. The graphite has now ignited, and you see the very brilliant manner in which it burns. It is, then, capable of being burned in this way in a current of oxygen, and, in burning, it produces nothing but this carbonic gas, or oxidised carbon as its product of combustion, proving that it consists of nothing else but, and is identical with, carbon. Now, this substance, graphite—this form of carbon—has been examined very carefully by Sir Benjamin Brodie, who has found that it has some very curious properties, and to some of these I will direct your attention. If we take charcoal, and act upon it by chlorate of potash and oil of vitriol, the effect is such that it is impossible by the eye to distinguish the product from ordinary graphite; but it differs from graphite in the effect of heat on it. You will see the black substance which we have at the bottom of the test tube covering it to the depth of half an inch or so; upon this I will now try the effect of heat. The action is already taking place, and you observe that the mass is beginning to grow. It is giving off steam, and now this substance, which has been partly acted upon by the acid, and become partly oxidised, has swollen up to such an extent as to occupy fully two-thirds of of the tube, and I have no doubt that, by continuing the heat a little longer, I may be able to push the substance up to the very extremity of the tube. It is still moving upwards, and getting nearer and nearer to my fingers every instant. The tube is now very nearly full; in another moment I shall not be able to hold it,—it will become so hot; and now you see that this black-lead, which formerly occupied a very small part of the tube, has swollen up and filled it.

Well, what is the nature of this change? It was only ordinary black-lead. We acted upon it by the mixture; I applied heat to to it, and thereby converted it into the original black-lead with which we started. Now Sir Benjamin Brodie has submitted some of this graphite to the action of very strongly oxidising agents, and has so converted it into a yellowish crystalline substance, which he calls *graphic acid*. I heat some of this graphic acid, which has kindly been supplied for this occasion by Sir Benjamin Brodie, and you will see that its behaviour is still more curious than that of the graphite with which I operated a minute ago. I take even a smaller quantity of this graphic acid than we did of the graphite. I apply heat to the flask containing the substance; you see, from the sparks, the combustion that is taking place inside the flask, and you also see the large amount of soot that is beng generated. [A pause]—The action is now over, and you will observe that our flask is completely full of soot. In this way, I have converted our graphite back into ordinary charcoal, of which I have here sufficient to fill the tube entirely.

I have told you one or two ways in which graphite may be made, and now I will show you another. You are all familiar with the diamond. Mr. Tennant has lent me a collection of diamonds which are in the tray before you. I am afraid they will not prove as interesting to the ladies as if they were mounted in a different fashion, but they are mounted in this way to display their various colours. Of course, the finest diamonds are colourless. You will see the beautiful manner in which these stones glisten now I illuminate them by the magnesium light; and if you take the trouble to examine them after the lecture, you will see that they are well worthy of examination, because they are not cut simply in the ordinary form, but so as to show that they present nearly all the colours which diamonds posses. Now, the diamond has this property—that it will stand a red heat. You may make it red hot, and it will be none the worse for it, but there is a degree of heat which it will not stand. The degree of heat, capable of being produced by the electric arc, alters the diamond; and into what does it alter it? Into a mass of graphite or plumbago. We come, then, to this conclusion,—that as diamond is the same thing as plumbago, and as plumbago in its composition is nothing more than ordinary charcoal, therefore diamond itself is only charcoal; and we can ascertain this fact in another way, for when a diamond is burnt in charcoal it yields this carbonic gas. I now want to show you the result of its combustion. Here we have a jar of oxygen gas, here we have a diamond, and here is an arrangement for making the diamond red-hot by means of a galvanic current. I introduce the diamond into our globe of oxy-

gen, and while there I will make it red-hot. When it has once become hot, it will burn in the globe for an instant or two. I am now making our diamond red-hot; it takes some little time to bring it to the proper heat: but as soon as this is attained, it will begin to burn. The burning of the diamond in oxygen is attended by the formation of carbonic gas, the presence of which is indicated by the ordinary lime-water test.

There is one further remark I wish to make to you relative to the diamond. It differs from plumbago in appearance, and also in specific gravity, for it is a very heavy substance. An ordinary piece of plumbago is about two and a quarter times as heavy as water. Charcoal is from one and a half to twice the weight of water, but the diamond is three and a half times as heavy, and hence is a very much heavier substance than ordinary charcoal, or even than plumbago; and so, again, with regard to electricity. There are some bodies through which the electric current will pass freely; through others it does *not* pass, as they are capable of resisting the current. Now, a diamond resists the current, whereas charcoal does not; thus a diamond differs from charcoal in this as well as in many other very important particulars.

I will now call your attention to a remaining property of carbonic gas, which is that, when it is compressed, it is capable of being actually brought into the liquid state. That iron vessel before you is at present filled with what was carbonic gas. It is so no longer; it is liquefied, and might be called *carbonic liquid*. It is like water in appearance, and consists of nothing but carbonic gas compressed into a liquid condition. This liquid is a very curious substance, and when, by removing the pressure, we allow it to escape into the gaseous state, it becomes intensely cold. Why it thus becomes cold I cannot stay to tell you, but when this reduction of temperature takes place, the substance is partly converted into the solid state. When converted into the gaseous state, or into carbonic gas, the liquid becomes so cold, and absorbs so much heat, that the remainder is converted, as I have said, into the solid state. I am now going to collect some of this solid substance in a box. I warn you that upon opening the cylinder there will be a little noise, but you must not be startled by it. Before putting the box upon the cylinder, we will allow some of the carbonic gas to escape, and you will see it solidifying in the air. [Some of the compressed gas was then allowed to rush out of the cylinder, and on doing so it formed a white snow-like shower of solid carbonic acid]. You see we thus get a large quantity of this carbonic snow.

I will now try to collect some of this solid matter in a box. [Some of the compressed gas was allowed to escape into a brass box, and there became solidified]. Our box is now full of the solidified gas, which I will empty out. That you may see how cold it is, I will place a piece of ordinary wet flannel round the box. You see that when I do so, the flannel is at once frozen so firmly to the box, that I can support its weight by means of the strip of frozen flannel. I will now take a portion of this solid gas and put it into a retort, and then you will see its gradual conversion into the gaseous state, and I shall be able to collect some of the gas over water. After putting the substance into the retort, I close it with a stopper, and that which was carbonic solid is gradually, as you see, converted into carbonic gas, and that gas is being collected over water. I will now give you another illustration of the property of this substance. Although it is so very cold, yet when I place a piece of it upon my hand, I do not feel it to be so; I can keep it there for a considerable time. The solid itself does not touch my hand, for it is separated by some of the carbonic gas into which it is becoming resolved, and hence it does not seem very cold to me, although it very readily froze the piece of flannel. If I let some of this substance come into contact with water, you will see its curious action; I will allow a piece to float on water, and you see it is gradually and very slowly evaporating. It does not freeze the water, although it froze the flannel in an instant. Here is another illustration of this property. If I take a common soda-water bottle, and fill it with ordinary water, I convert this ordinary water into soda-water, by adding to it some of this solidified carbonic gas. I will take a few pieces and drop them into a bottle of water. I then cork the bottle and shake it up for a minute or two, and we shall find that the carbonic gas so produced, dissolves in the water, and converts what was a bottle of ordinary water into a bottle of soda-water. [After a short interval]—The solid carbonic gas which I put into the bottle of water has slowly dissolved, and I know that the experiment has succeeded, because it is as much as I can do to hold the cork in the bottle. You see, when I remove my hand, that the cork flies out, and that we have obtained a bottle of soda-water which effervesces in the usual manner.

I will give you another illustration of the freezing properties of this solid carbonic gas. I here take a stool, and upon it I pour a little water. I then place upon the wet stool a glass beaker, into which I put some of the solidified gas. The evaporation from the substance contained in the glass is so rapid, that in an instant or two we shall succeed, I have no doubt, in freezing the beaker to the wet stool. [The freezing took place almost instantaneously, and,

in order to demonstrate the firmness of the adhesion, the lecturer lifted the stool by means of the glass beaker which was frozen to it]. You see the vessel is frozen to the stool with very considerable force, and a good deal of strength would be required to detach it.

I will now endeavour to freeze a quantity of mercury with a further portion of this solidified matter. [Some mercury was frozen by being brought into contact with the solid carbonic acid]. I have now frozen our mercury sufficiently for you to see the character of this freezing action. I hold the mercury by a wire, and, in this way, I can lift it. I will suspend the mass of mercury in water, where it will melt, and when it melts, you will see it pouring down through tubes of ice. Now when you consider that the temperature required to freeze mercury is exceedingly low—forty degrees below the freezing point of water—you will be able to form an idea of the great degree of cold which we can attain by the use of this solidified gas.

We have sufficient material left for a final experiment. I will put some of the solidified gas into a red-hot crucible, add a little ether, and then some mercury, and even then the mercury will be frozen. [The experiment was performed with a successful result.] We have succeeded in actually freezing mercury in a red-hot vessel. Here we have brought the mercury to a solid mass. I will now put it into some water, and it at once begins to liquefy, and as it liquefies it freezes the water, and forms little hollow tubes of ice, through which it falls to the bottom.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 4, 1869.

Dr. WARREN DE LA RUE, F.R.S., President, in the Chair.

THE names of the following candidates for election were read:—

For the first time—Mr. W. H. Deering, Assistant Chemist in the War Department, 12, Surrey Square, Old Kent Road.

For the second time—Mr. T. Bolas, St. Mary's Hospital; Mr. W. F. Catcheside, 12, St. Paul's Road, Camden Town; Mr. F. Clowes, 15, Cornwall Place, Holloway, N.; Mr. C. Hunt, London Gas Company, Nine Elms.

For the third time—Mr. J. J. Day, 173, Gloucester Road, Regent's Park.

The last-named gentleman was then duly elected by ballot.

The PRESIDENT regretted to have to announce that he had received a note from Dr. Frankland stating his utter inability to accept the office of president for the ensuing year. A new list would therefore be issued in a few days, in which the name of another gentleman would be substituted for that of Dr. Frankland.

Mr. TOMLINSON then read his promised lecture, "*On Catharism, or the Influence of Chemically Clean Surfaces.*" He commenced by referring to the previous researches of Oersted, Schönbein, and Liebig. In Oersted's researches, published in 1806, dilute acids were cautiously added, drop by drop, to solutions of alkaline carbonates; and similar experiments were made with other liquids. Almost no action took place at first; but on the introduction of any solid body, such as a platinum wire, a glass rod, or the finger, brisk effervescence occurs. He inferred that gas, in solution, is never given off except in contact with a solid, and he adduced the influence of solids in promoting crystallisation in support of his view. Analogous experiments were made by Schönbein in 1837, who suggested that the solids acted by carrying down air. Further illustrations were supplied by Liebig in 1839, who concurred in attributing the effects to the influence of the air introduced.

Mr. Tomlinson, after quoting these experiments, and giving some further instances of a similar kind, remarked that whether gas, vapour, or salt escaped from solution, most writers asserted the influence of some mysterious function in the air, while Gay Lussac imagined that the boiling point varied with the nature and condition of the vessel. In this he was followed by Löwel, who devoted eight or nine years to the investigation of supersaturated solutions. Mr. Tomlinson then explained the sense in which he applied the new term catharism (from καθαρος, *pure* or *clean*), distinguishing between "clean" in its ordinary and in its chemical sense. The finger could not be made chemically clean by any process, whereas a glass rod, cleansed with strong acids or alkalies, and well washed, was chemically clean, and no longer possessed the power of liberating either salt or vapour from liquids. The action of solid bodies in determining these changes he ascribes to the greasy film which, after exposure to the air, they are sure to acquire. For this film, the adhesion of the solid or vapour is greater than it is for the glass, and hence the effect of the solid. To such chemical uncleanness all phenomena of this kind should, he thinks, be ascribed, and he defines a nucleus as a body which "has a stronger adhesion for the gas, or the salt, or the vapour of a solution, than for the liquid which holds it in solution." He repudiates the notion that temperature has anything to do with the phenomena of supersaturation, and describes experiments in which supersaturated solutions of various salts were kept for hours in catharised vessels at a temperature of 10° F., without crystallisation taking place. This was even observed with alum, which does not usually exhibit this peculiarity. The views of Löwel on crystallisation, and the phenomena of *soubresaut*, or bumping, during ebullition, were next discussed, and a variety of interesting facts were described, for the particulars of which we must refer to the original paper. The action of porous bodies in assisting distillation was explained by their absorption of the vapour of the boiling liquids, which was subsequently given out in never ceasing jets; and a number of obscure phenomena in chemistry—such as the passive condition of iron, and the slight action of sulphuric acid on pure and amalgamated zinc—were explained by the doctrine of catharism, for which the lecturer claimed the properties of a principle of nature—viz., generality and breadth of application—a principle which was as yet new to science.

The PRESIDENT, in offering the thanks of the meeting to Mr. Tomlinson for his interesting paper, remarked that the main point appeared to be to determine the bodies which had the power of liberating gases from solution. The phenomena were very complex, and he did not quite see that we had arrived at an explanation of them.

Dr. W. A. MILLER did not suppose that Mr. Tomlinson's experiments had brought us nearer to knowing the cause of the difference in adhesion of different substances, but he thought that some advance was made by Mr. Tomlinson in tracing a number of widely different phenomena to one very generally operating cause.

Professor WILLIAMSON referred to the experiments which Mr. Grove described to the Society some years ago, in which he failed to get any ebullition in the absence of gas, and remarked that we could hardly doubt that the presence of air was favourable to the process. He objected to the use of the term catharism, as tending to draw the attention off from the particulars of the evidence before the facts were sufficiently well known and classified. In reference to the use of the term, it was well known that nothing produced the crystallisation of supersaturated sulphate of soda so easily as a crystal of the same salt, and yet it could not be said that such a crystal was not chemically clean.

Dr. GLADSTONE fully agreed that Mr. Tomlinson had cleared away the false explanations that had been given as to the influence of rough surfaces in promoting crystallisation on the evolution of gas, but doubted whether Mr. Tomlinson's theory was capable of explaining the phenomena in question. The nucleus, as Mr. Tomlinson defined it, had nothing to do with cleanliness or uncleanliness. Paraffin might be made perfectly clean, and yet it would certainly produce the effect of recovering a salt from solution. It would be better, he thought, to get rid altogether of the words clean and unclean in this matter.

Mr. VERNON HARCOURT thought it an objection to the principle of the paper that it was purely a negative principle. It would be more satisfactory if we could, as the President had suggested, learn of what kind the substances were which produced these results. In some recent experiments on the rate of decomposition of peroxide of hydrogen the speaker had found that when the dilute solution was heated in perfectly clean glass bulbs the evolution of oxygen was greatest; that it was less when the bulbs were not clean, and that it was reduced to a minimum by varnishing the bulbs inside. This seemed to be directly opposed to Mr. Tomlinson's theory.

Dr. ODLING believed that Mr. Tomlinson would be best rewarded for the interesting information which he had given by hearing the utmost possible number of objections to his views. He doubted Mr. Tomlinson's explanation of the action of nuclei in apparently homogeneous glass, and dissented from his conclusions on several other points. He remarked incidentally that it was scarcely fair to refer constantly to the very old experiments of Saussure's on the absorption of gases by charcoal, to the exclusion of the recent, and probably more accurate, experiments of Mr. Hunter. Mr. Tomlinson had found a new name for cleanliness, but had been more respectful to dirtiness. He said that catharism was a principle of nature, but it was open to question whether dirtiness had not a fair claim to be reckoned a principle of nature also.

Professor FOSTER did not think that Mr. Tomlinson had disproved De Luc's theory that air, or gas of some kind, was necessary for ebullition. The effect of cleaning a glass rod, for example, was, he thought, simply to cause the liquid to wet it more thoroughly, and so to exclude the film of air. He quoted a number of facts which seemed to support De Luc's theory.

Mr. HEISCH remarked that Mr. Tomlinson's theory could not apply to the passive condition of iron, because the immersion of only half an inch of an iron wire in strong nitric acid would render the whole wire, even 50 or 60 feet of it, passive to that acid, though not to another sample of it. The fact of the wire being cleaned by the nitric acid would not explain these facts.

Dr. CRACE CALVERT pointed out that acetic and carbolic acids possessed the same properties as sulphate of soda in a more remarkable degree. They might be shaken or stirred to any extent, with or without dirt, with any stirrers, clean or dirty, and in vessels that were far from being chemically clean, and they would remain perfectly liquid, whereas the introduction of a crystal the size of a pin's head would render the whole mass solid in a few minutes.

Mr. TOMLINSON, in reply, expressed his thanks to the president and the other fellows present for their full discussion and free criticism of his paper. In regard to the action of charcoal, he could not imagine, that when a piece of charcoal was heated to redness in sand and then immersed in mercury or in a boiling liquid, there was much air remaining in it. It could only act in virtue of its capillarity. After answering some other objections which had been urged, he remarked that he did not pretend to explain adhesion, but that it could not be doubted that there were differences in adhesion. He commented on Mr. Grove's experiment, and expressed his desire to see it repeated under different conditions. He denied the peculiar power of producing crystallisation usually ascribed to a crystal of the same compound. He had suspended clean crystals of sulphate of soda in the neck of the flask during the boiling of the solution, and found that when he pushed the crystals down into the solution, after twelve or fourteen hours, no crystallisation was produced.

Most of the other objections alleged were then discussed in detail, but the time prevented the consideration of all of them.

The society adjourned until Thursday, March 18th.

PHARMACEUTICAL SOCIETY.

Wednesday, March 3, 1869.

H. SUGDEN EVANS, Esq., Vice-President, in the Chair.

THE minutes of the previous meeting were read and confirmed.

After some remarks from Professor Bentley on some specimens of dried herbs, and from Mr. Hanbury on a specimen of blackish green insect wax forwarded from India by Dr. Baillie,

Mr. C. H. WOOD proceeded to read a paper "*On Sulphurous Acid.*" He found no difficulty in obtaining a 1·48 per cent solution in three hours, by passing a stream of the gas through water, and keeping the receiver as cold as possible; to obviate the inconvenience caused by a considerable amount of the gas passing off towards the end of the process, the operation can be carried on in the open air, but more charcoal and vitriol is required than ordered in the Pharmacopœia. The author preferred using a quicksilver bottle with a bent tube, to a glass retort. With regard to the test for strength, he had found that, by mixing 34·7 grains, by weight, with 1 pint instead of 1 ounce of water, as ordered in the Pharmacopœia, the proper proportion and accurate numbers were obtained.

Professor ATTFIELD confirmed Mr. Wood's statement regarding the test; he had thought the ounce was a misprint for a pint.

Professor REDWOOD could not plead that the ounce was a misprint for the pint, but he was of opinion that acid of the strength ordered in the Pharmacopœia was not so easily obtained or kept in a state of uniformity as one of much less strength. The committee of the Medical Council had sanctioned that the strength should be modified in the next edition of the Pharmacopœia, which, however, would not be published for some years; but as long as the process remained in the Pharmacopœia, it must be adhered to.

Mr. W. A. TILDEN, B.Sc., F.C.S., then read a paper "*On Diluted Nitro-Hydrochloric Acid.*" The author had endeavoured to find out if there was any advantage or difference in the process of mixing the acids and allowing them to stand before diluting, or diluting the acids at the time of mixture. Six drams of the acid, mixed and diluted at once with water, required for neutralisation 904 grain measures of the volumetric solution of soda, while 6 drams of the officinal acid required 870 grain measures. The difference in the saturating power of the pharmacopœia acid was accounted for by the loss of 1-50th of its volume. Nitric and hydrochloric acid being mixed

with the water at the time, in such proportions as ordered, will give a liquid that will answer the tests and be the B. P. acid, although not made according to its directions.

Professor Redwood said the reason for adopting the B. P. process was to get an acid at once that would contain free chlorine in solution. The process caused discussion in the Pharmacopœia committee—there was a contest as to how it was to be described; if the acids were to be mixed in a bottle stoppered or open, perfectly or partially stoppered. By mixing the acid in a capacious stoppered bottle, saving the gas, adding the water gradually, and shaking, an acid is obtained with the contemplated proportion of chlorine.

CORRESPONDENCE.

NOTES ON LECTURE EXPERIMENTS.

To the Editor of the Chemical News.

Sir,—Some time ago I called attention to the subject of lecture experiments, and stated that it would be of great service to those engaged in the work of science teaching if occasionally hints were thrown out in the columns of your journal for the proper performance of such experiments as one meets with in ordinary manuals, but which, in the majority of cases, are most incompletely put before the reader, as those who attempt to repeat the experiments soon discover. It is true the experimenter may soon find out the cause of failure and remove it, especially if he be one accustomed to lecture demonstration, but there is surely no necessity for hundreds of persons each to overcome the same difficulties, when a few lines in this column from any one of them would save trouble to the whole. Lecture experiments or more properly *demonstrations* are invaluable as a means of impressing facts upon the minds of students in science, and it appears to me that sufficient importance is not given to them in manuals. Besides this, as an additional and perhaps more weighty argument for a column specially devoted to lecture experiments, there are continually new modes of demonstration being devised, but for want of a recognised journal in which to record them they are lost, except to the few who may have been present when they were exhibited.

I would venture to ask you, sir, in the name of myself and several of my friends who are engaged in science teaching if you would allow a column occasionally in your journal for notes and queries respecting lecture experiments not doubting, from the reasons I have given above, that by so doing you would be conferring a favour on a large number of your readers.—I am, &c.,

C. J. Woodward.

Midland Institute.

SPURIOUS GUANO.

To the Editor of the Chemical News.

Sir,—In reply to the objections raised by your correspondents, Messrs. Rees, to my remarks on this subject, I beg to say that those remarks were based upon the analysis and account given of the manure by themselves; that in those remarks there was not anything either "unwarrantable" or "set against" the analysis and reports since published in your columns, which confirm, as might have been expected, the analysis by Mr. Ogston, and furnish the most complete justification I could wish for of my estimate as to the value of the manure.

The analysis and reports on this manure do not bear out the assertion that "it is undoubtedly the most valuable that has yet been offered to the farmer," or the statement that the chemists referred to give "the highest opinions" of the value of this manure, nor do they accord with the statement that, in reference to its composition, it is a cheap manure, for none of the chemists named put an actual money value on the manure, but merely term it "a very valuable manure," which may fairly be said of it or of any other manure worth more than £5 per ton; and Dr. Voelcker's recommendation is judiciously qualified by the proviso "if it can be sold at a reasonable price."

The manure is said to consist of a "basis" of Peruvian Government guano, but, at any rate, it contains, "amongst other ingredients," superphosphate of lime, which is of lower value than that guano.*

As my friend, Mr. Ogston, has thought it necessary to say a few words in reply to me, the fitness of which, from his point of view, I can appreciate, and am quite willing to admit, it is with much regret that I see he has gone out of the way to charge me with having made a very unjustifiable attack upon his clients, and to misrepresent me as having stated there was "no Peruvian guano at all" in the manure. No such statement was made by me. Mr. Ogston is also in error in stating that Dr. Voelcker, Professor Anderson, Mr. Way, Mr. Sibson, and himself, differ from me on all points. This is not the case; for the analyses of those gentlemen are, in fact, the basis and justification of my opinion. Mr. Ogston has, of course, full right to hold or express a different opinion, but I venture to think he is not justified in presuming to assert that I cannot be familiar with the subject on which I wrote, and in doing this he has gone beyond his province. Mr. Ogston, I am sure, is sufficiently conversant with the value of manures that, if his client were a farmer, he would not assign to a manure having the composition represented by his analysis a value of £11 per ton; and I do not believe that in any case he would have certified such to be the case.—I am, &c.,

B. H. Paul.

8, Gray's Inn Square,
March 6th, 1869.

CHEMISTRY OF SUGAR REFINING.

To the Editor of the Chemical News.

Sir,—In No. 472 of volume xviii. of your excellent publication is an able and exhaustive paper by Dr. Wallace, "On the Chemistry of Sugar Manufacture and Sugar Refining," wherein occurs a passage to which exception must be taken, as it is of a nature to create false impressions.

After speaking of the injurious action of weak acids, which invert cane sugar, and enable liquors to dissolve iron from animal charcoal and from iron tanks and cisterns, besides other impurities, Dr. Wallace adds, "In this way Mr. Beanes's process for treating animal charcoal with hydrochloric acid gas, although otherwise all that can be desired, has entirely failed, and has caused ruinous expense to some refiners who have used it."

While admitting the premises of Dr. Wallace, I fail to see how he arrives at his conclusion. Were it true that Mr. Beanes's process produces weak acids, the conclusion would be perfectly legitimate.

I feel authorised to speak on the subject of Mr. Beanes's process for purifying bone-black. I was one of the first in the United States who became acquainted with the process, and for the last two years I have had charge of it at the refinery of Messrs. Havemeyers and Elder, in Brooklyn, E.D., opposite New York. They refine 100 tons of sugar daily, and treat weekly 220,000 lbs. of bone-black by the process of Mr. Beanes. They have now three large apparatus for making the hydrochloric acid gas in constant operation, and are putting up more retorts.

In view of my experience, I deny that weak acids must necessarily be formed in the sugar solutions by the use of Mr. Beanes's process, except under the most careless

* Owing to the pressure on our space, we are obliged to omit from this letter a tabular comparison of the published analyses of the guano under discussion, with an analysis of Peruvian guano made in 1856 by Mr. Way.

and unskilful management. Only two circumstances can give rise to the formation of weak acids in connection with the process of Mr. Beanes. Either the bone-black is left acid and the liquor dissolves acid from the bone-black, or the water left in the bone-black weakens the liquor sufficiently to allow fermentation to take place readily.

At the refinery of Messrs. Havemeyers and Elder there is no trouble from either cause of acidity. The sugar solutions after filtration are neutral.

I am led to believe, from the passage of Dr. Wallace's discourse quoted above, that an account of the means we employ to avoid acidity in the bone-black would be of use to the refiners in England who purify their bone-black by Mr. Beanes' process. I may briefly state that acidity is prevented in the bone-black—

1. By using peroxide of manganese in the hydrochloric acid generator, to avoid the formation of sulphurous gas.
2. By saturating the bone black with hydrochloric acid gas only when it is dry and very hot, as it comes from the revivifying kilns.
3. By using the hydrochloric acid gas dry.
4. By allowing the saturated bone-black to stand in suitable receivers till the excess of gas, if any, is absorbed before washing.
5. By washing the bone-black thoroughly after saturation to remove the chloride of calcium and other soluble salts.

It may be well to state that the use of wet bone-black in the filters consequent on the employment of the process of Mr. Beanes, is not of itself a cause of acidity in a refinery. On the Continent of Europe, and I believe in England, the bone-black is often used wet in the filters without any harm resulting from this practice. Differences of results obtained from the use of wet black must be due to differences of management.

In the two largest refineries in the United States, that of Messrs. Havemeyers and Elder of New York, and the Franklin Sugar Refinery of Philadephia, also at Las Canas, the Sugar Estate of Don Juan Poey, the scientific planter of the island of Cuba, the process of Mr. Beanes has been adopted, is working successfully, and the best results have been obtained.

Dr. Wallace renders a just tribute to the process of Mr. Beanes when he says that it is "otherwise all that would be desired." I am able to add that it is not necessarily a source of acidity in a refinery.

The apparatus in use at the above-mentioned establishments differs from the one previously in use in the manner of drying the hydrochloric acid gas, which is accomplished without the use of chloride of calcium.

Hoping that the above may prove useful to the sugar refiners of England,—I am, &c.,

P. CASAMAJOR.

98, Wall Street, New York,
February 22nd, 1869.

MISCELLANEOUS.

Solubility of Indigo.—M. Camille Kœchlin has discovered the curious fact of the solubility of indigo in alkaloid salts, and particularly in the acetates and chlorides of aniline, morphine, &c.

Fearful Explosion.—On Wednesday afternoon a terrible explosion occurred at the works of Messrs. Demuth and Co., the well-known carbolic acid manufacturers. A retort burst, and set fire to a number of barrels of naphtha. Two of the *employées* were burnt to death, and four others received very serious injuries.

Scientific Instruments.—We understand that Mr. Heisch has relinquished the proprietorship of the business at 69, Jermyn Street, carried on under the name of Murray and Heath. He is succeeded by Mr. Robert Murray, whose father established the business, and as he has for many years acted as manager for Mr. Heisch, he will, we believe, fully maintain the just reputation this firm has acquired.

Remarkable Property of Teroxide of Thallium.—Chemical processes enable teroxide to be obtained with great facility as a dark brown powder, presenting a striking resemblance to peroxide of lead. All that is necessary for this is to digest by heat some newly precipitated chloride of thallium in a solution of hypochlorite of soda, containing an excess of alkali. If a mixture of this dry teroxide and flour of sulphur is submitted to a moderate friction it ignites with explosion. When, on the contrary, to the same teroxide is added the eighth of its weight of the product vulgarly called golden sulphur, it is observed that the ignition requires less rubbing, and takes place without explosion. We may then hope, sooner or later, for a useful pyrotechnic application of this product. Among other properties, M. Böttger calls attention to that which this mixture possesses of being set on fire by the faintest electric spark, far surpassing in this respect the known mixture of equal parts of chlorate of potash and black sulphuret of antimony. The author observes, by the way, that the picrate of oxide of thallium detonates also very easily under a blow.—*Jahresbericht des Physikalischen Vereins in Frankfort*, and *Dingler's Polytechnisches Journal.*—

Chrome Green.—Oxides of chrome are prepared either in the dry or wet way; obtained thus, they vary from greenish grey to a more or less deep greenish yellow. They generally have neither brilliancy nor freshness. It is possible, however, to produce green oxides of chrome which are not devoid of beauty. One of the most intelligent chemists of the commercial world, M. Casthelaz, has, conjointly with M. Leune, prepared a chrome green, which is justly styled imperial green. This colouring matter of a superior brilliancy is obtained exclusively by the wet way. The process consists in slowly precipitating chrome salts by treating them with hydrated metallic oxides, insoluble, or but slightly soluble, in water, or by hydrated metallic carbonates, or hydrated metallic sulphides, or, again, by other salts of weak acids, which easily leave their bases; the action is only produced progressively, and the oxide of chromium is precipitated in the hydrated form; the colour of the compound is magnificent, of a deep emerald green. For this preparation, it is convenient to adopt economical reagents, such as gelatinous alumina, oxide of zinc, carbonate of zinc, sulphide of zinc, &c., whose price is reasonable. The same result may be obtained by treating a chrome salt with the non-alkaline metals, which have a sufficient affinity to unite with the acid of the chrome salt and precipitate the oxide. Iron and zinc will be more particularly used, as they are cheaper. It is necessary to select from among the metals, with their oxides and salts, those which, with the acid of the chrome salt, give soluble salts, as they should be removed by washing. If recourse is had to reagents forming, with the acid of the chrome salt, insoluble salts, it is only in order to modify the colour and composition of the chrome precipitates and of the green colour thus formed. As to the magnificent imperial green colour obtained by M. Casthelaz, it possesses properties which will enable manufacturers ultimately to renounce the justly condemned and dangerous copper and arsenic greens. The use of the imperial green removes all danger from insalubrity; it is an impalpable substance, of perfect tenuity. It is believed that this property will cause the new green to be adopted for printing on stuffs, and for other purposes. The oxides of chrome known up to the present time, and generally obtained in the dry way, cannot, by pulverisation, attain to the degree of fineness of the imperial green. It is expected that this substance will have great success in oil painting, coloured papers, colours, and artificial flowers, printing, lithography, perfumery, and soap manufacture, as well as in the making of glass and in the ceramic arts.—*Moniteur Scientifique.*

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3965. A. G. Gazalat, Rue Gaillon, Paris, "Improvements in the manufacture of steel, and in the apparatus employed therein."—Petition recorded December 30, 1868.

337. L. Wray, Ramsgate, Kent, "An improved process for carbonising and hardening wrought-iron."—February 3, 1869.

355. F. Braby, Camberwell, Surrey, "Improvements in the treatment and utilisation of the waste solution of sulphate of iron resulting from the cleansing of iron surfaces in the process of galvanising."—February 5, 1869.

419. P. Taysen, Leith, Scotland, "Improvements in the manufacture of stearic and oleic acids."—A communication from J. C. A. Bock, Copenhagen, Denmark.—February 10, 1869.

434. H. Edwards, Staple Inn, Holborn, "An improved preserved food."

442. W. E. Newton, Chancery Lane, "Improvements in the manufacture of explosive compounds."—A communication from A. Nobel, Paris.—February 12, 1869.

460. A. H. Lewis, Fenwick Street, Liverpool, "Improvements in extracting copper from its ores."—A communication from T. S. Hunt, Montreal, and J. Douglas, jun., Quebec, Canada.—February 15, 1869.

469. L. N. Legras, Wardour Street, Middlesex, "Improvements in the preservation and disinfection of animal and other substances, and in the apparatus employed therein."

473. C. E. Brooman, Fleet Street, London, "Improvements in treating the waste of wool, silk, horn, and other nitrogenised animal matters to be used as manure."—A communication from P. Pichelin, Orleans, France.

488. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved method of obtaining benzole and its homologous substances from coal gas."—A communication from H. Caro, A. Clemm, C. Clemm, and F. Engelhorn, Mannheim, Baden.—February 17, 1869.

NOTICES TO PROCEED.

3154. W. E. Gedge, Wellington Street, Strand, "Improvements in the manufacture or preparation of artificial fuel."—A communication from C. de Lin, and A. C. Dalma, Rue Blondel, Paris.—Petition recorded October 15, 1868.

3177. E. T. Hughes, Chancery Lane, "An improved adhesive substance."—A communication from J. Totin and A. Totin, Montreuil, France.—October 17, 1868.

3203. G. Chapman, Glasgow, N.B., "Improvements in treating sewage in order to obtain valuable products therefrom."—October 20, 1868.

3248. J. Baggs, High Holborn, "Improvements in smelting, carburising, and purifying iron."

3250. J. Spratt, High Holborn, "Improved preparations of food for horses, cattle, game, poultry, and other domestic animals, such preparations being capable of admixture with compounds for the production of a medicated food for man."—October 24, 1868.

275. N. C. Szerelmey, Belgrave Road, Pimlico, "Improvements in making tarpaulin in different colours, and in treating sail-cloth and other fabrics to preserve them from rapid destruction by the sea air and other corroding influences."—January 29, 1869.

NOTES AND QUERIES.

Guano of Mexillones contains, according to Bobierre's analyses, 33 per cent of phosphoric acid, equal to 71·5 per cent of tribasic phosphate of lime.

Silicated Hydrogen.—Mr. Freidel has just discovered that this gas is entirely decomposed by the electric spark, giving rise in the eudiometer to a shower of amorphous silicium of a brown colour.

Fibrin of Blood.—According to Messrs. Béchamp and Estor, the substance denominated fibrin of blood is only a kind of membrane formed by the microzymas of the blood associated or accompanied by a substance secreted by them by means of the albumenoid substances of the blood.

Aniline Black.—"New Berne" is referred for this matter to the CHEMICAL NEWS, August, 1866, p. 59, and to the volumes of Elsner's *Chemisch Technische Mittheilungen*, published annually since 1846, all of which may be inspected at the free library of the Commissioners of Patents.

Preservation of Hydriodic Acid. — This acid is kept and properly preserved in a white state in the presence of turnings of copper; the iodide of copper which is slowly formed is not dissolved by the acid; hydriodic acid which has has become brown-coloured will be restored to its pure colour when shaken up with copper turnings.—*Deutsche Industrie Zeitung.*

Aniline Black for Cotton.—"New Berne" enquires in the "Notes and Queries" whether there is an aniline black for cotton. There is an aniline salt used in this district by many calico-printers which, treated with an oxidising paste made on purpose for it, produces a black considered the best out. If your correspondent will apply to S 48, Post Office, Manchester, he can learn all about it.

Atomic Weight of Lanthanum.—M. Zschiesche has prepared sulphate of lanthanum of such a purity that a thickness of 17 centimetres of a saturated solution gave no trace of the absorption bands of didymium. Working on this, he has found the atomic weight of lanthanum to be, from a mean of six experiments, 45·09. The extremes were 44·72 and 45·625.—*Journ. de Chim. Prat.*

Picrate of Quinine has been tried, according to the *Revue Maritime et Coloniale*, in the French Navy and some French settlements in Asia and Africa where a peculiar kind of ague was prevalent, but it has not been found to answer at all well, as it affects the digestive organs; besides this picric acid, although intensely bitter to the taste, is now considered not to possess any medicinal properties which would render it peculiarly valuable; its internal use tinges the skin yellow.

Action of Aqua Regia on Sulphur.—Mr. Lefort has studied the action of aqua regia upon sulphur and sulphur ores; he finds that at first there is a chloride of sulphur formed by the disengaged chlorine, but soon after this compound is again destroyed by the action of the nitric acid, and chlorine is set free, while sulphuric acid is formed. Lefort finds that the best proportion of the mixed acids most suitable for the rapid oxidation of sulphur is 1 part of hydrochloric and 3 of nitric acids, precisely the reversed proportion as used for ordinary aqua regia.

Mr. Sorby's Researches on Diamonds.—Mr. Sorby finds that the supposed cavities in diamonds described by Brewster are in reality enclosed crystals, and the conclusion arrived at from the consideration of the whole structure of the diamond is not opposed to its having been formed at high temperature. The crystals enclosed in diamonds are frequently seen to be surrounded by a series of fine radiating cracks, which are proved to have been the result of the contraction suffered by the diamond in solidifying over the enclosed crystal, and this explanation has been artificially verified by examining crystals formed in fused globules of borax glass, cooled slowly, when the same phenomena are seen.

Assay of Gold Quartz.—First let the rock containing gold be roasted at a red heat, as is practised with regard to flints intended for pottery ware manufacture; this roasting renders it easy to break the rock afterwards into small pieces. In this state the rock should be placed in a large earthenware (fire-clay) tube fixed in a furnace in a manner similar to the large fire-clay retorts used in the manufacture of gas (double retorts), open at both ends and projecting beyond the furnace on each end; the heat in the interior of the tube should be bright cherry-red. If, under these circumstances, a current of chlorine gas be passed through the retort, the gold contained in the rock will combine at the high temperature with the chlorine, and become volatile therewith, whereas at the place where the heat of the tube or retort is less high, the chloride of gold will become again decomposed and gold deposited.

Will Steam Ignite Combustible Substances?—This curious question is discussed in a recent number of the *Scientific American*. It is urged that as the heat generated by a hydrocarbon in combination with a combustible fibre will produce combustion, and as a fibrous material saturated with oil will, if exposed to the sun's rays, burst into flame, it follows that a greater degree of heat, whether produced by steam or any other agency, may produce like results. After mentioning the inflammable condition acquired by wood through which a steam pipe has been passed, it is remarked that every engineer of some experience and close observation knows that it is possible to ignite combustible or inflammable substances by the direct impact of steam. Cases are on record where dry wood was ignited by escaping steam, and, as an experiment, oil-saturated cotton waste and dry pine wood have been lighted by the steam from a boiler at a distance of 12 feet, the pressure of the steam being at the time only 95 lbs., and the temperature of the steam, inside the boiler, *not* at 12 feet distance thereof, 335° F.; the material burst into flame in a few minutes. I witnessed many years ago a case where a quantity of racine, *i.e.*, madder root not yet ground, took fire simply by being heated up to about 210° F. by means of the waste exhaust steam from a small high-pressure steam-engine being made to pass through a series of pipes, above which the racine was placed on an iron grating in a layer some 4 inches in thickness.—Dr. A. A.

MEETINGS FOR THE WEEK.

MONDAY, March 15th.—Medical, 8.
—— London Institution, 6.
TUESDAY, 16th.—Royal Institution, 3. Rev. F. W. Farrar, "On Comparative Philology."
WEDNESDAY, 17th.—Society of Arts, 8.
—— Meteorogical, 8.
THURSDAY, 18th.—Royal Institution, 3. Dr. H. Power, "On the Eye."
—— Royal, 8½.
—— Zoological, 4.
—— Chemical, 8. Arthur Elliott, "On the Determination of Carbon in Cast-Iron." B. T. Chapman, "On Butylic Alcohol."
FRIDAY, 19th.—Royal Institution, 8. Dr. Crum Brown, "On Chemical Constitution."
—— Quekett Microscopical Club, 8.
SATURDAY, 20th.—Royal Institution, 3. Dr. Odling, "On Hydrogen and its Analogues."

*** Owing to press of matter, our answers to correspondents are unavoidably postponed till next week.

* Reported verbatim, by permission of the Author, for this Journal.

of a piece of ice yields water. If we heat the

sulphur still further, it will boil just like water, and in that way we obtain sulphur gas, which is a vapour of a deep orange colour. Here is some sulphur which is at present liquefied; in a minute or two it will boil, and then the flask containing it will be full of the vapour of sulphur, which you will recognise by its deep orange colour. Just now the vapour is scarcely visible, for the sulphur does not yet fairly boil; it is now beginning to do so, and soon you will see the flask filled with a deep orange-coloured and perfectly transparent gas or vapour. This gas, or vapour is characterised by its considerable weight, by its dark orange colour, and by the facility with which it is changed back into the liquid state; wherein it differs from oxygen gas, although in some respects it corresponds very closely with it. You will remember that not only do ordinary combustible substances, such as coals or candles, burn in oxygen gas, but certain metals also. I showed you the combustion in oxygen of zinc and of iron; I will now show you the burning of some metals in this vapour of sulphur, and you will see that they burn in it very much the same as in oxygen. I take a piece of copper, and first warm it a little; I then introduce it into the sulphur vapour, and you see that it burns very completely, just as our piece of iron did in oxygen. You see that when I introduce the piece of copper into the sulphur vapour, the copper becomes brillantly hot, and gradually consumes in the interior of the flask, which gets filled with this deep-coloured vapour. In this particular, sulphur vapour corresponds very closely with oxygen. Now, will a piece of charcoal burn in this deep orange-coloured sulphur-gas or vapour, which is now quite visible? I light a piece of charcoal: if I put it into a globe of oxygen it would burst into a flame; but when I put it into sulphur vapour it is immediately extinguished—it will not burn in sulphur. Nevertheless, it can be made to enter into combination with it; that is to say, if, instead of trusting for the necessary amount of heat to the burning of the charcoal in the sulphur vapour, we heat the charcoal strongly, and keep it strongly heated whilst in the sulphur, then the carbon and the sulphur will enter into combination one with another. When iron and oxygen burn, we get oxide of iron; sulphur and copper burnt together yield disulphide of copper, just as by combining copper with oxygen we obtain oxide of copper. Now, if we introduce the heated charcoal into sulphur vapour, and burn it there by keeping it hot, we get disulphide of carbon.

What is the nature of this disulphide of carbon? In the first place, ordinarily a liquid. Here we have some specimens of it. You will remember that the carbonic gas can be liquefied, and I showed it to you in that state; in the same manner we can gasify disulphide of carbon. This tube, which looks as if it were empty, contains some of the gas of disulphide of carbon. This gas is very easily reduced into a liquid state; if I allow the ordinary weight of the atmosphere to press upon it, the mercury will rush up the tube, and some of the vapour will be converted into liquid. By putting on a little pressure from my mouth, I can convert the whole of this gas into liquid. [The pressure of the atmosphere was allowed to operate on the contents of the tube.] You see the mercury already begins to rise, showing that we have converted a considerable quantity of our disulphide of carbon gas into disulphide of carbon liquid. By blowing into the tube with a little force, I shall be able to push the mercury up to the top of the tube, and by that additional pressure the whole of the disulphide of carbon gas will be converted into a liquid, just as by means of an iron vessel I was able at the last lecture to pump a great quantity of carbonic gas into the interior of the vessel, and so obtain it in a liquid condition. You will notice that when, through my blowing, the mercury reaches the top of the tube, it will strike it with a slight noise, which many of you will be able to hear. This disulphide of carbon, then, we may regard as a substance which is sometimes in the liquid state, with a strong tendency to become a gas or vapour, and sometimes in the gaseous state, with a strong tendency to become a liquid.

Now for some of the properties of this compound when in the liquid state. I ought to warn you that disulphide of carbon, whether a liquid or a gas, is characterised by a somewhat disagreeable odour. Perhaps on this account I ought not to bring it before you, but it has properties so remarkable in many respects that I cannot refrain from introducing it. First with regard to its weight. It is very much heavier than water; to show you how heavy it is I will pour some of it into this water. In these experiments I usually colour the water blue or red, to render it visible to you, but in this instance I have coloured it brown by using iodine for reasons which you will presently understand. I pour some of this disulphide of carbon through the brown water, and you see it at once falls to the bottom; and something else also happens. The liquid poured into the brown water was colourless, but now that it has fallen to the bottom through this brown liquid it has become decidedly pink in colour; but there is something more. I shake the two liquids up together, and you will find, I think, that the disulphide of carbon will take away all the brown colour, and instead of itself becoming brown it will become pink. It is a very curious circumstance with regard to

this iodine, that it dissolves in some liquids forming a brown liquid, but that on dissolving in disulphide of carbon it forms a deep pink. The disulphide of carbon has fallen to the bottom and assumed its beautiful crimson colour, and I think we shall find that by the time it has quite settled we shall have two distinct layers of liquid, and the upper one will be colourless. You will observe how colourless the supernatant water will eventually become. Disulphide of carbon is heavier than water, in the proportion of about thirteen hundred to a thousand; that is to say, if we were to take a volume of water which weighed a thousand grains or a thousand pounds, and the same volume of this disulphide of carbon, we should find the disulphide of carbon weighed thirteen hundred grains or pounds. But, although this substance is heavier than water, it is not so heavy as a saturated solution of salt. [This fact was illustrated by a small quantity of a saturated solution of salt being placed at the bottom of a vessel of disulphide of carbon, and there remaining.]

Now for another property of this disulphide of carbon. It consists of sulphur or brimstone, and charcoal, and both brimstone and charcoal are very combustible or easily burning bodies; and the fact that the brimstone and the charcoal are in combination instead of being separate, does not at all interfere with their combustibility. Accordingly, if I moisten a sponge with a little disulphide of carbon, and bring it to the flame, you see that it at once burns with a lambent blue flame. There are two or three very interesting points connected with the combustion of this substance. When it burns, and there is sufficient air, the charcoal is converted into oxidised or burnt charcoal, in the form of carbonic gas, and the sulphur into oxidised sulphur or sulphurous gas. But if there is not sufficient air what will happen? The charcoal only will be burnt. You will remember that when we took an ordinary candle, or a gas flame, and cut off the supply of air, the hydrogen only was burnt and not the charcoal. In the present case when the supply of air is insufficient for perfect combustion, the charcoal burns and the sulphur does not. That is one interesting point connected with the burning of disulphide of carbon. The other is, that it is one of those substances which are ignited with the greatest ease. I have here an ordinary test tube containing a little olive oil. I heat this up to a temperature a long way short of red heat—a temperature which corresponds to about four hundred degrees Fahrenheit, or about twice as high as that of boiling water. The tube of oil being sufficiently hot, I will place it in the disulphide of carbon vapour, and I want to show you that with that tube of hot olive oil I shall be able to set fire to the disulphide of carbon. I will pour a little of the substance into these glasses, and then try to ignite it, not by a match or a lighted taper, but simply by this tube of heated oil. [Disulphide of carbon vapour was inflamed by the tube of hot oil.] You see that we can readily set fire to this substance by means of a little heated oil. It is, in fact, one of the most easily combustible of all the common substances known to chemists. It gives off vapour, or becomes vapourised, very easily and very quickly, and, moreover, the gas or vapour of the disulphide of carbon is very heavy. It is much heavier than carbonic gas which I showed you in a previous lecture, for whereas carbonic gas is only about one and a half times as heavy as air, this is two and a half times as heavy. I will give you an illustration of these two points together—the great facility with which this substance is converted into vapour and the heaviness of its vapour; and then, thirdly, I will illustrate to you its inflammability. I have here a piece of sponge moistened with the disulphide; I put it at one end into the corner of this long flat box, and under these circumstances it will give off vapour. I want to see at what distance I can light the vapour which is given off from the moistened sponge. The vapour will doubtless fill the box, and I shall be able to ignite it from the extreme end or corner of the box. I approach the flame carefully with the light, and when the vapour is lighted, it shrinks at once to the other end. You see that it is very easy to ignite, and difficult to extinguish. I will now give you some further illustrations of the heaviness of this disulphide of carbon. Here I have a bottle apparently empty, but really containing disulphide of carbon gas. I will pour a little of this heavy gas into this tall jar, just as the other day I poured the carbonic gas. I take our apparently empty bottle, and having poured the gas from it into the jar I apply a light and ignite the gas. Now we will see whether we cannot go a little farther. We have now two glasses; I take the bottle containing the disulphide of carbon vapour, and fill this first glass with it. I now pour some of the gas from the first into the second glass, into which I put a light, and you see the gas takes fire. I will repeat the experiment, using three smaller glasses instead of the two larger ones. I take the bottle of gas, and begin by filling this first glass; I transfer a portion of the contents of the first glass into the second, and next I pour a portion of the gas from the second glass into the third. Now we will see whether all these three glasses contain this inflammable gas. [A lighted taper was applied successively to the third, second, and first glasses, and in each instance the presence of the disulphide vapour was manifested by its ignition on contact with the flame.] We might go on in this

way; indeed, I have extended the experiment to as many as four or five glasses. Now I have here a glass barrel, which is apparently empty, but really containing this disulphide of carbon vapour, and so heavy is the vapour that I shall be able to draw it out from the tap of the vessel. I hold a beaker under the tap, and so draw into it a little of the vapour. Our beaker being sufficiently full for our purpose, I turn off the tap, and on bringing a light near the beaker, the gas contained in it takes fire. I will give you one more illustration of the weight of this disulphide of carbon. You know it is a very common practice to draw off liquids by means of a syphon, and I will try whether this can be done in the case of this vapour. I insert one end of the syphon in the vessel of vapour, and fill the syphon in the ordinary way by sucking it. Our syphon is now full, and the gas issues from the end of it. I hold these vessels under the syphon in order to receive the gas which is flowing from the end of it, and you see that I can thus catch the gas, and then I shall be able to set it on fire.

I have given you several illustrations of the facility with which this substance is converted into vapour, and also of the inflammability of the vapour. I want now to show you that if I vapourise it more rapidly, which may be done in a current of air, I can produce a great amount of cold. In my last lecture I showed you the amount of cold that could be produced by the vapourisation of the liquefied carbonic gas. Now I want to show you the amount of cold that can be produced by the vapourisation or gasification of liquid carbonic disulphide. I pour some water on the top of this stool, and then place the beaker on the wet part. I next pour some disulphide of carbon into the beaker, and blow a current of air upon it. By this means our disulphide of carbon is very quickly converted into vapour. It is now rapidly vapourising, at the same time producing a very intense cold, and I have no doubt that in a minute or two this beaker will have become so firmly frozen to the stool that I shall be able to hold up the latter by means of the beaker, just as I did the other day when illustrating the cold produced by the spontaneous vapourisation or gasification of the solidified carbonic gas. You will remember that in that case I allowed the vapourisation to take place spontaneously. In the present instance I cause the vapourisation by a current of air which is being blown upon the liquid from below. [After a short interval the glass beaker was found to be frozen to the top of the stool.] It is now frozen, but I will allow it to remain a little longer so as to make sure that it is frozen sufficiently firmly to allow me to hold up the stool by the glass. [After a short pause]—Here you see I am lifting up the stool by the beaker; the two adhere so closely that it requires some considerable force to separate them.

In the experiment just performed I vapourised some disulphide of carbon simply by blowing air upon it; but now I am going to boil it, and I want to show you what a beautiful and extensive flame may in this way be produced. It is a liquid which both boils and vapourises very quickly. It is beginning to boil, and you see the beautiful lambent flame with which it burns. I now turn on a supply of oxygen, and in this I burn the disulphide vapour. I want you for an instant to form an idea of the length of this brilliant and peculiar blue flame; but I must not let it burn long, because it produces a great deal of sulphurous gas, which is very unpleasant.

The last property of this disulphide of carbon to which I wish to call your attention is the mode in which it burns, not in oxygen or in air, but in another gas which I have not hitherto considered in my lectures on carbon, namely, an oxide of nitrogen, and I will show you the very brilliant manner in which the disulphide of carbon will burn in it. Here we have a cylinder of the gas, and here, in this small glass globe, is our disulphide of carbon. I let the disulphide of carbon globe fall to the bottom of the jar, and, of course, in doing so it breaks, as you see, and I shake it up with the other gas. [The mixture was then ignited, and produced a very brilliant flash of light]. This is the last experiment that I have to show you with this liquid or vapour, which, although very interesting, is very disagreeable in many respects.

(To be continued).

ON THE CRYSTALLISATION OF IRON.

DURING an examination of the Heaton process for making steel at Langley Mill, in which I have been lately engaged for the purpose of reporting thereon, I noticed a remarkable instance of the crystallisation of iron. After the violence of the action between the molten iron and the nitrate of soda has subsided, the lower portion of the apparatus, called the converter, is detached, and after a few minutes the contents are turned out in a porous mass of nearly ¾ of a ton in weight on to the floor. Upon examining portions of this metallic sponge, I find it consists of a segregation of minute feathery crystals of iron, apparently built up of small cubes. The outlines of some of these are perfectly sharp, and their appearance, especially in the cavities, is very beautiful.—W. CROOKES.

Alizarine.—Mr. Martin, taking advantage of Schützenberger's investigation of madder, has invented a process for transforming orange-madder, purpurine, pseudo-purpurine, and xantho-purpurine into alizarine. The several colouring matters are first dissolved in concentrated sulphuric acid; next, powdered zinc is added, and heat applied: when the reaction is completed, the mass is diluted with water; an abundant precipitate falls, which is the required dye; this after washing with water is ready for use.

ON THE

IMMEDIATE ANALYSIS OF DIFFERENT VARIETIES OF CARBON.

By M. BERTHELOT.

(Continued from page 113.

GRAPHITIC oxides and their derivatives form a special group, quite distinct from the ordinary combinations of organic chemistry. Let us now inquire what are the relations between these two sorts of compounds, and whether they are to be explained within the circle of analogies drawn from the study of other hydrocarbon compounds.

The transformation of graphitic compounds into ordinary organic compounds, say, carbides of hydrogen, is easily effected by heat and electricity; the different carbons and graphites, under the action of the electric arc, combine directly with hydrogen, and produce acetylene, a true organic compound capable of directly forming all the other organic compounds properly so-called.

Carbides of hydrogen may also be formed with graphites by working with carefully managed reactions at a temperature not exceeding 280°. The same treatment must be used as with amorphous carbon, instead of working on the pure carbon, which cannot be combined at a low temperature with free or nascent hydrogen; begin by oxidising the carbon, and then introducing the hydrogenising action of iodhydric acid.

The oxides thus formed do not immediately produce carbides of hydrogen with the hydracid, which only changes them into hydrographitic oxides possessing special properties; but pyrographitic oxides, which are easily prepared by heating graphitic oxides, are nearer than these latter to the state of amorphous carbon, and therefore more easily oxidised or hydrogenised. By heating to 280° pyrographitic oxide from plombagine with 80 parts of iodhydric acid, I obtained hydrogen containing six hundredths of marsh gas. To ascertain the nature of the carburetted gas, I treated the gaseous mixture with absolute alcohol, determined the quantity dissolved, and made a comparative analysis of the gas undissolved and that dissolved, then re-evolved by ebullition, the latter consisting of a mixture of 36 parts of marsh gas and 64 of hydrogen. A suitable calculation founded upon the previous experiments, and upon the co-efficients of solubility, proved that the gaseous carbide was really marsh gas, C_2H_4. However, the whole substance does not undergo the change which produces the marsh gas; a considerable portion remains under the form of a black carbonaceous powder; the composition of this powder is also changed, for, when subjected to heat, it evolves a small quantity of inflammable vapour, which appears to be acetone. An addition of nitric acid and chlorate of potash will change this powder entirely into soluble products, with the exception of from 1 to 2 thousandths of graphitic oxide.

Pyrographitic oxides derived from cast-iron and electric graphite behave in exactly the same manner.

These facts show at once the speciality of constitution which distinguishes graphitic oxides from other organic combinations, and the conditions under which that speciality is gradually effaced, until the common order of combinations is regained. The difference must not, however, be exaggerated; it strikes us the more forcibly because we are led to compare graphitic oxides with gaseous or volatile hydrocarbons; this is not, in my opinion, the true mode of comparison. In the first place, the products of oxidation of graphites do not wholly differ from those of oxidation of amorphous carbon; both are fixed, and represent very condensed bodies; only the carbonic products are soluble, and the others insoluble. The passage from the characteristics of one group to those of the other becomes very apparent upon examining certain oxidised compounds derived from amorphous carbon; for instance, those derived from carbon produced by treating benzine or naphthaline with iodhydric acid. These products are dark yellow, amorphous, and precipitable by salts from their solution or aqueous emulsion, and are the intermediary compounds between graphitic oxides and those of amorphous carbon. These latter present much similarity to the products of oxidation of ulmic matter and other analogous condensed compounds.

The properties of graphitic oxides are not without analogy; their brisk decomposition is accompanied by the same formation of water and carbonic acid as in that of fixed acids and other highly oxygenated organic compounds. The lively evolution of heat which occurs at the same time may also be observed, though less intense, in the pyrogenated decomposition of acids and hydrates of carbon. Graphites, amorphous carbons, and their derivatives, may therefore be most suitably compared to hydrates of carbon and ulmic matter. In the series of gradual decompositions to which organic principles may be submitted, when decomposition occurs by molecular condensation, the brown and ulmic compounds immediately precede the carbonaceous substances, which appear still more condensed, and these again precede the carbons properly so-called. The special structure of these compounds is demonstrated not only by their origin, but also by the hydrogenising action of iodhydric acid, which reproduces saturated carbides corresponding with their generators, either the carbonaceous matters themselves, or the products of their oxidation.

The different varieties of amorphous carbon represent, therefore, certain polymeric conditions of the true carbonic element as it exists in the most widely disseminated hydrocarbonated combinations. The same conclusion applies to the different graphites. I shall show in my next that the most simple compounds of carbon are divided into two groups, according as they reproduce by their decomposition amorphous carbons properly so-called or graphitic carbons. All these substances must then be polymeric with the true carbonic element, as yet unknown, supposing it to exist in a free state and in a non-condensed form similar to that of the gaseous elements.—*Comptes Rendus.*

ON THE

NON-PRECIPITATION OF MANGANESE BY SULPHIDE OF AMMONIUM IN PRESENCE OF SOME ORGANIC AMMONIACAL SALTS.

By Prof. HOW, D.C.L., Windsor, Nova Scotia.

IN conducting the process of Reynolds (CHEMICAL NEWS, vol ii., p. 208), for the separation of iron and alumina, by precipitating the former metal by sulphide of ammonium after addition of oxalic acid, I found that some of the manganese present remained dissolved along with the alumina. Unprepared for this retention, and failing to find any information as to the behaviour of manganese with sulphide of ammonium in presence of organic acids, I was led to experiment on this subject, and now give such of my results as seem to possess novelty and interest.

The oxalate of manganese recently described by myself (CHEMICAL NEWS, vol. xix., p. 41), appears to be much more soluble in dilute hydrochloric than in dilute sulphuric acid, and hence, doubtless, oxalic acid does not throw down the salt so soon or so abundantly from the chloride as from the sulphate of the metal. If a large quantity of oxalic acid is used with the chloride, and excess of ammonia and some sulphide of ammonium are quickly added, no sulphide of manganese falls, but the characteristic needles of the oxalate soon appear. When chloride, oxalate, and sulphide of ammonium are successively added to chloride of manganese, both sulphide and oxalate of this metal fall after a short interval. When

the oxalate is dissolved in dilute HCl, successive addition of oxalic acid, ammonia, and sulphide of ammonium gives no precipitate of sulphide; and, on standing, crystals, consisting, no doubt, of an oxalate, are formed—perhaps the double salt mentioned by Gerhardt, and alluded to in my paper above cited. When solid tartaric acid is warmed in solution of $MnCl_2$, the subsequent addition of ammonia and sulphide of ammonium causes no precipitate. The same result is obtained when citric acid is employed. In both cases no manganese is thrown down on standing twenty-four hours.

The other metals of the fourth group fall, either at once or after a short time, as sulphides when the before-mentioned solutions retaining manganese dissolved in presence of sulphide of ammonium are added to their salts formed with mineral acids.

It does not appear that attention has been given to the deportment of manganese now described. Fresenius says the metal may be precipitated as sulphide from all compounds without exception (Quant. Anal., third English edition, p. 169), and mentions sulphide of ammonium as the proper precipitant (p. 170). H. Rose points out that manganese is not completely thrown down as sulphide, especially in liquids containing salts of ammonia (CHEMICAL NEWS, vol. ii., p. 302), but he makes no mention of organic acids.

From the fact that oxalic and tartaric acids do not prevent the precipitation of sulphide of manganese by sulphides of the fixed alkaline metals, it seems that the joint presence of these acids and of ammonia (only) is necessary to retain the metal in solution on addition of sulphide of ammonium. I find that citric acid, dissolved in solution of $MnCl_2$, prevents precipitation on addition of potash and sulphide of potassium, and such solution, after standing twenty-four hours, precipitates sulphide of nickel from the nitrate of the metal immediately on its addition.

It would be interesting to enquire whether the retention of manganese now described depends on the production of manganos-ammonium, mentioned by Gerhardt, and alluded to in my paper on the oxalate of manganese referred to above.

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Continued from p. 91.)

Unwholesome and Adulterated Food.

As regards vegetable foods, they are not so liable to decay or even to parasitic infection as animal foods; for the acari or mites of flour and sugar, or even the weevels of biscuit are harmless; indeed, the most important infection of grain is the fungoid disease of it, called ergot. This is the muttercorn or roggenmutter of the Germans, and as it chiefly infests the rye, it is named, from its appearance, spurred rye; but it also attacks barley, oats, wheat, maize, rice, and most of the grasses. It always appears as a black grain, of a larger size than usual, and it is mostly found in plants which grow upon moist clay soils, in damp situations, especially in the neighbourhood of forests. The district of Sologne, in France, between the rivers Loire and Cher, was once notoriously infested with the disease, and the Abbé Fessier, who was deputed in 1777 to investigate the causes of the extraordinary prevalence of ergot in that district, attributed it to the poorness and wetness of the land, and to the dampness of the air from the numerous forests. In bad seasons, as much as a third or a fourth of the crop was infected with ergot, and even in good seasons it constituted about two per cent of it. The disease in the grain is due to the growth of a peculiar fungus, which the late Mr. Quekett named *ergotetia abortifaciens*, and the effects of it on the human body are very serious. It acts chiefly on the nervous system, causing giddiness, dimness of sight, loss of feeling, and twitching of the limbs, and death by convulsions; or it produces a creeping sensation over the surface of the body, with coldness of the extremities, followed by insensibility and gangrene. These effects are no doubt referred to by Ligebert in his "History of Gaul and France," when he says that the year 1089 was a pestilent year, especially in the western parts of Lorraine, for many persons became putrid in consequence of their inward parts being consumed by St. Anthony's fire. Their limbs were rotten, and became black like coal, and they either perished miserably, or, being deprived of their putrid hands and feet, were reserved for a more miserable life. Bayle, too, in his account of this sickness, says that the bread was of a deep violet colour. The like effects have been observed in other parts of the Continent, as in Silesia, Prussia, Bohemia, Saxony, Holstein, Denmark, Switzerland, Lombardy, and Sweden, where the creeping sickness, as it is called, has attacked whole districts of the country, sparing neither old nor young, rich nor poor.

The remedy for the disease is in the hands of the miller, who should separate the ergotised from the healthy grains. Fortunately we have a ready test for its presence, not merely in the microscopic appearances of the flour, but in the circumstance that as it is the lightest of all the constituents of flour, it will float upon a mixture of one part of chloroform and six of alcohol, and will appear as a scum of dark-brown particles.

Another source of danger is the presence of poisonous grasses in the flour. The most important of these is darnel (*lolium temulentum*), which the careless or slovenly farmer will sometimes permit to overrun his fields, and the seeds becoming mixed with the corn, are ground into flour by the equally careless miller. The effect of the grains on man is to cause a species of intoxication, with headache, giddiness, somnolency, delirium, convulsions, paralysis, and even death. Occasionally it excites vomiting, with irritation of the alimentary canal, and then its effects are not so serious. Many instances are recorded of the poisonous action of the flour. Christison, for example, tells us, that a few years ago almost all the inmates of the poor-house at Sheffield, to the number of eighty, were attacked with analogous symptoms, after breakfasting on oatmeal porridge, and it was supposed that the effects were caused by the presence of darnel in the oatmeal. A similar accident is mentioned by Perleb, as having occurred at the House of Correction at Freyburg, and still more recently the same effects were produced on seventy-four persons at the workhouse of Beninghausen. Dr. Taylor states, on the authority of Dr. Kingsley, of Roscrea, that in the month of January, 1854, several families, including about thirty persons, suffered severely from the effects of bread containing the flour of darnel seeds. Those who partook of the bread staggered about as if they were intoxicated, and although they all recovered, yet they experienced a good deal of distress from giddiness, coldness of the limbs, and great prostration of vital power.

Unripe grain, as well as grain affected with the rust, and mouldy flour and mouldy bread, have also produced disturbance of the human system. M. Bouvier attributed the epidemic of dysentery, which occurred in the department of the Oise, in the autumn of 1793, to the use of unripe grain; and corn affected with brown or black rust is thought by many to be unwholesome. Mouldy flour or mouldy bread is certainly injurious, for several instances are on record where not only men, but horses, have been poisoned by mouldy bread; and M. Payen has given a graphic account of the distressing effects of the mouldy ammunition bread supplied to the troops who were encamped near Paris, in 1843; the mould on that occasion was a yellow fungus, the *oidium aurantiacum*, but at other times it has been of a green colour, from *penicillum glaucum*.

Mouldy food of every description is dangerous to use,

* The Cantor Lectures, delivered before the Society of Arts.

and considering to what an extent the spores or sporidia of poisonous fungi are floating in the atmosphere, it is surprising that they do not more frequently taint our food and cause disorder of the system, for air washed with distilled water will always yield abundance of these germs, which are ready at any moment to spring into activity when they come into contact with a proper nidus for their growth. A remedy for these hidden sources of danger is good and effective cooking.

And now, in conclusion, let me make a few remarks on the subject of the fraudulent sophistications of food—a subject which has been very popular for the last fifty years, or rather, I should say, since the year 1820, when Mr. Frederick Accum published his treatise on "Adulterations of Food, and Culinary Poisons," with the startling motto from the Book of Kings—"There is death in the pot." As you may easily imagine, such a terrible announcement by a well-known writer, could not fail to excite alarm in the public mind, and to provoke anxious curiosity. The book, therefore, was eagerly sought for, and a thousand copies of it were sold within a month of its publication; so that, to use the words of the author, in his advertisment to the second edition—"there was sufficient inducement to reprint the work." The singular success of Accum's undertaking has been such a temptation to others, that the press has literally groaned with the efforts of sensational writers on this subject. And although I am ready to admit the importance of it, yet I am bound to state that it has often been grossly exaggerated, especially by those who have had but little practical knowledge to guide them.

The objects of fraudulent adulterations of food are three-fold:—

1. To increase the bulk or weight of the article.
2. To improve its appearance.
3. To give it a false strength.

Among the first of these adulterations are the following:—

(*a*). The addition of inferior starches, as potato-starch or English arrow-root, curcuma or East Indian arrow-root, jatropha or Brazilian arrow-root, tacca or Tahiti arrow-root, canna or Tous-les-mois starch, sago-meal, &c., to true maranta, or West Indian arrow-root—of which Bermuda arrow-root is the most esteemed variety. A microscopic examination of the starch or fæcula will always discover the fraud.

(*b*). The mixture of starch-sugar or even starch itself with common cane-sugar. Starch-sugar, or as it is sometimes called, grape-sugar, or glucose, is manufactured both in this country and on the Continent to a considerable extent. It is made from any description of starch, by boiling it for half-an-hour or so in water containing about one per cent of sulphuric acid. The acid is then neutralised with chalk, and the liquor evaporated to a density of 1·28. While hot, it is run off clear from the insoluble precipitate of sulphate of lime, and on standing in a cool place for a few days it crystallises or sets into a solid mass. This description of sugar has a low sweetening power—not half so great as that of cane-sugar—in fact, it is produced from the latter by the action of vegetable acids and heat, when cane-sugar is added to fruit in making a tart or fruit pie, and in making jellies and jams. It is false economy, therefore, to sweeten to any extent before the tart is baked. The sugar is known by many characters, as a want of sparkle from the absence of well-formed crystals, its less solubility in water and greater solubility in alcohol, and by its giving a deep port-wine tint to a solution of potash when it is boiled with it.

(*c*). The dilution of milk, vinegar, &c., with water. This fraud is easily detected by the specific gravity of the liquid, and, in the case of milk, by the proportion of cream in the lactometer, and by the poor appearance of the milk when under the microscope.

(*d*). The mixture of dripping and other fats with butter, and water and starchy matter with lard. Butter and lard should always furnish, when melted, a clear-looking oil, with but little deposit of water or other substance.

(*e*). The addition of gelatine to isinglass, which is sometimes so well managed that it requiries a skilful analysis to detect it. Isinglass is an organised substance, and when examined with the microscope, exhibits a peculiar structure which is very characteristic of it; not so, however, with gelatine. A particle of isinglass put into cold water remains opaque, like a piece of white bread, and does not swell out, whereas gelatine becomes transparent, and enlarges a good deal in bulk. Jelly made from good isinglass has a slightly fishy smell, and is neutral to test-paper, but that from gelatine has a distinct odour of glue and an acid reaction. Lastly, if a few grains of isinglass be burnt in a metal spoon until the ash alone remains—the ash will be very small in quantity, and of a reddish colour, while that of gelatine will be much larger in amount and of a white appearance. Gelatine never agrees with the delicate stomach of an invalid like isinglass; and, therefore, it is often important to discover the difference.

(*f*). Coffee adulterated with chicory is readily detected by sprinkling the mixture upon water, when the coffee, which is slightly greasy from volatile and fixed oil, floats while the chicory sinks, and gives a brownish tint to the water. The experiment is easily made, as you here see, in a tumbler of water, and you may, with a little tact, determine the proportions of the mixture.

(*g*). Wheaten flour is frequently added to flour of mustard, and when the quantity passes beyond a certain amount, it is undoubtedly an adulteration, for the intention of it should be only to reduce to an agreeable extent the pungency of the mustard.

(To be continued).

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 23, 1869.

R. ANGUS SMITH, Ph.D., F.R.S., Vice-President, in the Chair.

"*On Sulphurous Acid in the Air of Manchester*," by PETER SPENCE, Esq., F.C.S.

Believing, as I do, that the evils of our town smoke are in a much larger degree due to the gases which result from our coal consumption than to the black smoke, which is the one thing generally complained of and legislated against—it occurred to me that one of these gases, which has a most pernicious influence upon vegetation, and which can hardly be favourable as a constant breathing medium to animal life, could be made visible in its effects to the eye. This is sulphurous acid gas, a very considerable product of the combustion of coal, containing 2 per cent sulphur on an average.

The experiments I have made have been repeated some fifteen to twenty times, and in two localities; the results are evident, and are now before the Society. I used litmus papers, exposing one series of slips in the middle of the lawn at my house, at Smedley, about two miles nearly due north from the centre of the town, so that any wind between west, south-west, and east-south-east covers us with the smoke of a large section of Manchester, and, as these winds blow four-fifths of the year, Smedley has the lion's share of the town's smoke.

The slips were changed at eight in the morning and at six in the evening, so that they represent alternately day and night, and I may say that the results almost completely ignore the effects of large chimneys, the night slips being as decidedly acted upon as the day's, and none

of them more so than the night between Saturday and Sunday morning. The effects are in remarkable connection with the state of the wind or set of the atmosphere, so much so that if shown a slip exposed there for twelve hours I could almost tell from it in what direction the wind had been. During most of the days and nights of exposure the wind was south, coming over the broadest section of Manchester; on Sunday it changed to east, coming over Harphurhey and Mosten; although the apparent smokiness was not much less, the colouring was slighter.

Gilda Brook, near Eccles, where the other slips were exposed, is west of Manchester, and fully three miles from the centre of the town, and there, even with an east wind, the diffusion of the gas is seen in the more slight colouring.

I am still continuing the exposures, and shall, probably, in addition to this, attempt to measure the actual quantity of SO_2 on some day when Smedley has the benefit of the fullest sweep of the Manchester atmosphere.

As to the effects of these gases upon vegetable life, I have full proof at Smedley; vegetable life on the whole of that side of town is a mere struggle for existence.

As an instance, as I am leaving it for the opposite side, where only a due north wind, which almost never blows, will bring me the smoke, I have been able to try its effects upon about twenty plants of camelias: these I had at Smedley, most of them for eight years, and the blooms had dwindled down year by year till, in the spring of 1868, I had only three or four miserable specimens. Early last May I moved them to the south side of town; nothing else was done to them: they made their growth as usual, only more vigorously, and showed abundance of flower buds,—this they had frequently done at Smedley, but there they generally nearly all dropped off; this season they dropped none: they are now and have for the last three weeks been covered with beautiful blooms, and I have no hesitation in saying they have brought to maturity more in number than they did in all the eight years at Smedley.

The Chairman stated that he had made experiments many years ago on the air of Manchester, and had found a large quantity of sulphurous acid, which was frequently converted into sulphuric acid. There was also a large quantity of muriatic acid. These gases were brought down by every drop of rain, in sufficient quantity to redden litmus paper. He considered that smoke, as well as the gases, was very detrimental to both animal and vegetable life.

GLASGOW PHILOSOPHICAL SOCIETY.

Chemical Section.

A meeting was held in the Hall, Andersonian University, on Monday, the 15th inst., at eight o'clock in the evening, Dr. Anderson, the President, in the Chair.

Two members were admitted by ballot.

W. H. Perkin, Esq., F.R.S., read a paper entitled "*Observations on some Artificial Colouring Matters.*" We hope to be able to give a further notice of this paper in an early issue.

ROYAL GEOLOGICAL SOCIETY OF IRELAND.

There was a meeting of this Society on Wednesday evening, March 10th, Sir D. Corrigan, Bart., in the chair. This meeting was the first of a series of intended joint meetings of the Royal Geological and Zoological Societies, to be held in the Museum Buildings of Trinity College.

Mr. M. H. Ormsby, LL.D., of the Geological Survey of India, read a communication, dated June 19th, 1868, from Mr. A. Dempster, describing the Prince of Wales gold mine at Sebastopol Ballarat. The paper was accompanied by specimens of the workings. The matrix yielded in washing 30 grains of gold for every 14 ounces.

NOTICES OF BOOKS.

"*Obituary Notices of Deceased Fellows.*" (*Proceedings of The Royal Society*, Nov. 30th, 1868).

"*Faraday as a Discoverer.*" By John Tyndall. Longmans, Green, and Co., 1868.

In our impression of August 30th, 1867, we had the melancholy duty of announcing the death of our great countryman, Faraday. The short, and in many respects imperfect, sketch which we then placed before our readers was written hastily and under the influence of feelings which could not fail to suggest themselves at such a time.

Since then, affectionate friends, comrades, and fellow-labourers of the great philosopher* have, in the truest spirit of love and veneration, collected a mass of information regarding his life both as a man and an investigator, which we heartily commend to the perusal of our readers. At the time when we wrote our first notice of Faraday, it was difficult to obtain reliable information regarding his early life and studies. His temperament was so completely averse to every kind of self assertion or display, that it was necessary for him to die before all his greatness could be known. Fortunately for the world, two of Faraday's friends have had the means, the inclination, and the opportunity of giving us, not sketches, but finished pictures of his outer and inner life.

Even with the comparatively meagre information we possessed in August, 1867, we ventured to assert of Faraday that "he was the only man who has raised himself to the first rank in science in this country, whose every attribute we may fearlessly hold up as a model to our children!" If we wrote thus when we did, how much more shall we not repeat it with the light now before us? There can be no stronger proof of the goodness as well as greatness of Faraday than the deep affection with which he inspired his friends.

The obituary notice of Faraday in the *Proceedings of the Royal Society* is written by Dr. Bence Jones, and it is a model of what such notices should be. Instead of the feeble, rambling, and often half-hearted panegyrics we are so much accustomed to, we have a clear, well written, chronological history of his life, occupying sixty-eight closely-printed pages; but, owing to the perfect method and concise mode of expression, there is more matter in it than in two hundred pages written in the slip-shod manner too commonly adopted by biographers. We shall make no apology for presenting our readers with an outline of Faraday's life, greatly condensed from Dr. Bence Jones's notice.

Æt. 1 *to* 12 (1791 *to* 1804).—Michael Faraday, the third son of James Faraday, was born at Newington, in Surrey, September 22nd, 1791. His father worked as a blacksmith at Boyd's, in Welbeck Street, and, after living for a short time in Gilbert Street, they removed, when Michael was about five years old, to rooms over a coach-house, in Jacob's Well Mews, Charles Street, Manchester Square. This was the home of Faraday for nearly ten years, in fact, until 1809, when they moved to 18, Weymouth Street.

When thirteen years old (1804) he went on trial for a year to Mr. George Riebau, a bookbinder.

Æt. 13 *to* 19 (1805 *to* 1811).—On the 7th of October, 1805, Faraday was apprenticed to Riebau, and in consequence of his faithful service his master dispensed with a premium. Here Faraday first saw Mrs. Marcet's "Conversations on Chemistry," and the treatises on electricity in the "Encyclopædia Britannica." These works appear to have had the effect of giving him his first draughts of scientific knowledge. As may be supposed, he at once commenced making such experiments as were possible with his limited means.

At this period he also attended lectures on natural philosophy, given by Mr. Tatum.

* "Faraday loved this word and employed it to the last; he had an intense dislike to the modern term *Physicist*."—Tyndall.

Æt. 20 (1812).—Through the kindness of Mr. Dance, who was a customer of Riebau's, and a member of the Royal Institution, he was enabled to attend four of the last lectures of Sir H. Davy. At this period, "the desire to be engaged in scientific occupation, even though of the lowest kind, induced me, whilst an apprentice, to write, in my ignorance of the world and simplicity of my mind, to Sir Joseph Banks, then president of the Royal Society. Naturally enough, 'no answer,' was the reply left with the porter."

He now began to construct small galvanic batteries; and the tenor of his letters at this date shows that his mind was entirely bent on scientific pursuits.

On the 8th of October he went as journeyman bookbinder to a Mr. De la Roche, a French emigrant, in London. This man was of a violent temper, and caused Faraday much trouble.

Encouraged by Mr. Dance, he sent Sir Humphry Davy the notes he had taken of his last four lectures. The reply he received was immediate, kind, and favourable. Although still working as a bookbinder, he at this period acted for a few days as amanuensis to Sir Humphry Davy, who was suffering from a wound in the eye received during his examination of chloride of nitrogen.

Æt. 21 (1813).—One night, while living in Weymouth Street, he was startled by a loud knock at the door, and a footman, who had alighted from a carriage, left a note for him from Sir Humphry Davy. This letter was to offer him a situation as assistant in the laboratory of the Royal Institution.

He was soon at work on various investigations for Sir Humphry; amongst others, on chloride of nitrogen. He had four violent explosions while engaged in its examination. One of these occurred while holding a tube containing 7½ grains of the chloride. His hand was blown open and a part of one nail torn off. Fortunately, he wore a glass mask, which saved his eyes. As it was, the mask was cut by the pieces of the tube.

Æt. 22 (1814).—He visited Rome with Sir Humphry.

Æt. 23 (1815).—Still in Rome. His life at this time was to some extent troubled by the fact that Sir Humphry imposed tasks upon him connected with domestic duties, which should never have been proposed to him. It would appear, however, that Sir Humphry was very careful not to give him work which he disliked, as soon as his objection to it was known to him. Lady Davy, on the other hand, gave him much annoyance from her domineering propensities. A fortnight after his return to England, his salary as assistant in the laboratory was raised to 30s. a week, and rooms were given him.

Æt. 24 (1816).—He now gave lectures on chemistry, at the City Philosophical Society, and published his first paper, "An Analysis of Native Caustic Lime," in the *Quarterly Journal of Science.*

Æt. 25 (1817).—He published a paper "On the Escape of Gases through Capillary Tubes." He was also hard at work at his education.

Æt. 26 (1818).—Gave five lectures at the City Philosophical Society, and published six papers in the *Quarterly Journal*, the most important being "On Sounds produced by Flame in Tubes."

Æt. 27 (1819).—This appears to have been a comparatively uneventful year with Faraday.

Æt. 28 (1820).—First paper read before the Royal Society. It was "On Two New Compounds of Chlorine and Carbon, and on a New Compound of Iodine, Carbon, and Hydrogen." Experiments in conjunction with Stodart, on the alloys of steel.

Æt. 29 (1821).—His marriage, and admission into the Sandemanian Church. Paper in conjunction with Phillips "On a New Compound of Chlorine and Carbon." Succeeds in causing the wire to move round the magnetic pole and the pole round the wire.

Æt. 30 (1822).—Comparatively uneventful.

Æt. 31 (1823).—Papers in *Transactions of the Royal Society*, "On Fluid Chlorine," and "On the Condensation of several Gases into Liquids." Four papers in the *Quarterly Journal of Science.* Proposed as Fellow of the Royal Society. Elected Corresponding Member of the Academy of Sciences, Paris.

Æt. 32 (1824).—Elected Fellow of Royal Society, and of Geological Society.

Æt. 33 (1825).—Made Director of the Laboratory of the Royal Institution. Discovered benzol.

Æt. 34 (1826).—Paper "On Action of Sulphuric Acid on Naphthalin;" "On the Existence of a Limit to Vaporisation;" "On Pure Caoutchouc, &c."

Æt. 35 (1827).—Commenced researches on optical glass. Published his "Chemical Manipulation."

Æt. 39 (1831).—Published the first series of "Experimental Researches in Electricity."

Æt. 40 (1832).— Second series of "Experimental Researches in Electricity."

Æt. 41 (1833).—Third, fourth, fifth, and sixth series of "Experimental Researches." Elected Fullerian Professor of Chemistry.

Æt. 42 (1834).—Seventh, eighth, and ninth series of "Experimental Researches."

Æt. 43 (1835).—Tenth series of "Experimental Researches." Granted pension by Lord Melbourne. Awarded one of the royal medals by the Royal Society.

Æt. 44 (1836).—Appointed adviser to the Trinity House. Made senator of the University of London.

Æt. 45 (1837).—Eleventh series of "Experimental Researches."

Æt. 48 (1840). Sixteenth series of "Experimental Researches." Appointed elder in the Sandemanian Church.

Æt. 51 (1843).—Eighteenth series of "Researches."

Æt. 52 (1844).—Paper communicated to Royal Society, "On the Liquefaction and Solidification of Bodies generally existing as Gases."

Æt. 53 (1845).—"Researches on Magnetisation of Light and the Illumination of Magnetic Lines of Force.

Æt. 56 (1848).—Twenty-second series of "Researches."

Æt. 58 (1850).—Twenty-third to twenty-seventh series of "Researches."

Æt. 61 (1853).—Sent to *Athenæum* his "Experimental Investigation of Table Turning."

Æt. 63 (1855).—Made Commander of the Legion of Honour.

Æt. 64 (1856).—Last paper sent to Royal Society: "Experimental Relations of Gold (and other metals) to Light."

Æt. 66 (1858).—Offered a house at Hampton Court by the Queen. Researches on Regelation, printed in Tyndall's paper "On Ice of Irregular Fusibility."

From this period, the record of his life ceases to be marked by events connected with his researches. He continued to give vast numbers of reports to the Trinity House, and at times gave lectures. But his health was rapidly declining, and his memory not to be relied on.

It need not be said that, in the declining years of his life he was tended with unfailing devotion and care, not only by affectionate relatives, but by friends whose veneration and love were as great as it was possible for those of relatives to be. Tyndall gives the following touching account of the last time Faraday spoke to him (p. 168):—

"Sometimes, during the last year of his life, by the permission or invitation of Mrs. Faraday, I went up to his rooms to see him. The deep radiance, which in his time of strength flashed with such extraordinary power from his countenance, had subsided to a calm and kindly light, by which my latest memory of him is warmed and illuminated. I knelt one day beside him on the carpet, and placed my hand upon his knee; he stroked it affectionately, smiled, and murmured in a low soft voice the last words I remember as having been spoken to me by Michael Faraday."

It is charming to find throughout Tyndall's entire work such a deep reliance on the goodness and kindness of Faraday. He is not, however, a mere blind adorer; he analyses with wonderful skill Faraday's mental process, and wherever he feels it his duty to differ with him he

does it faithfully, but with the gentleness and tenderness of a loving son.

Every one who has read attentively Faraday's paper "On the Magnetisation of Light and the Illumination of the Magnetic Lines of Force," must have been surprised at its title: the writer well remembers how intensely *he* was puzzled by it. Dr. Tyndall says on this subject, "In November, 1845, he announced his discovery of the 'Magnetisation of Light and the Illumination of the Lines of Magnetic Force.' This title provoked comment at the time, and caused misapprehension. He therefore added an explanatory note; but the note left his meaning as entangled as before; in fact, Faraday had notions regarding the magnetisation of light which were peculiar to himself, and untranslatable into the scientific language of the time. Probably no other philosopher of his day would have employed the phrases just quoted as appropriate to the discovery announced in 1845. But Faraday was more than a philosopher; he was a prophet; and often wrought by an inspiration to be understood by sympathy alone." Then, after a lucid explanation of the experiment itself, Tyndall goes on to say, "His magnet turned the plane of polarisation of the beam through a certain angle, and thus enabled it to get through the analyser, so that 'the magnetisation of light and the illumination of the magnetic lines of force' becomes, when expressed in the language of modern theory, *the rotation of the plane of polarisation.*"

We need not say that, if Dr. Tyndall was happy in the friendship of Faraday, Faraday was to be congratulated that his mantle, (which Tyndall modestly says is almost too heavy to be borne), has fallen upon such shoulders.

Dr. Tyndall's work is illustrated by two exquisite portraits of Faraday. The frontispiece is engraved from a negative taken some years ago specially for Dr. Tyndall. The portrait facing p. 79 is a gem in its way. It is from a daguerreotype by Claudet, taken when Faraday was about fifty years old. We consider, however, that the engraving we present to our readers this week, is a still more striking likeness of the great philosopher. It is printed from a block in the possession of the Editor, and is probably not to be surpassed in vigour and truthfulness.

In conclusion, we earnestly recommend Dr. Tyndall's work, not merely as a charming biographical sketch, but as a masterly analysis of the mind of one of the greatest and best men the world has ever produced.

CORRESPONDENCE.

THE NEW EARTH IN SOME ZIRCONS.

To the Editor of the Chemical News.

Sir,—The history of the discovery of absorption bands in certain zircons is so thoroughly given in the Chemical News for the 12th inst., that I am reluctant to trouble you with any further communication on the subject. Yet I cannot refrain from commenting on three or four remarks in Mr. Sorby's valuable letter therein given.

1. Mr. Sorby says that I observed (1866) the spectrum of the new element in a "very imperfect manner." But the new spectrum which was then described was soon found to be more complex; while a rough pen and ink sketch in a letter was not likely to represent it faithfully. But how does my drawing really differ from Mr. Sorby's? The chief differences arise, not from the imperfection of my observation, but from the intense absorptive power of the specimen of jargoon from which I drew the figure. This caused at once a broadening of the bands, and in some cases, a coalescence of two bands into one. But after all it will not be surprising if the greater skill and better instruments of Mr. Sorby have enabled him to make a more accurate drawing.

2. My remark as to the Ceylon and Norway zircons showing the bands referred, of course, only to those few transparent specimens which I then possessed. I have since met with many stones from both localities which showed either no bands or mere traces of bands.

3. Mr. Sorby says I was led to conclude that the production of the bands might depend on the presence of Svanberg's norium. I "hazarded the conjecture," but all I concluded was, that the presence of these bands in the spectra of some zircons and their absence from others showed that the bands must be due to some substance other than zirconia.

4. In conclusion, I may say that my studies and analyses of several well-marked black-band zircons have convinced me that the new earth will not be found "to constitute the chief ingredient of some of the jargoons from Ceylon:" I very much wish that this was likely to be the case.

I reserve a fuller account of my results till they have been rendered more complete by further research. I propose to continue to devote my attention to the chemical and analytical side of the inquiry; the physical study of the zircon could not have fallen into more approriate or abler hands than Mr. Sorby's.—I am, &c.,

A. H. Church.

Royal Agricultural College, Cirencester,
March 15, 1869.

BIPHOSPHATED PERUVIAN GUANO.

To the Editor of the Chemical News.

Sir.—In spite of Mr. B. H. Paul's attempted explanation of his first letter, and his assertion that the analyses of our manure justify the use of the expressions contained in that letter, we still think his attack unwarrantable.

We decline further correspondence with Mr. Paul, but as we are bringing our action against him with as little delay as possible, he will have another opportunity of explaining his views on the subject.— We are &c.,

Rees and Co.

32, King William Street, London,
March 16, 1869.

MISCELLANEOUS.

The Gas Inspectorship for the City.—Mr. Charles Heisch, F.C.S., was on Thursday last elected to the office of Gas-Examiner to the City of London. This gentleman is known from his connection with the firm of Murray and Heath.

New Pocket Spectroscope.—Mr. W. Ladd, of Beak Street, Regent Street, has invented a small pocket spectroscope, which is, without exception, the most powerful for the size we have ever seen. It consists of a lens, a system of direct vision prisms and a slit. The system of prisms, containing 3 flint and 2 crown, is about ¾ of an inch long, and the whole only occupies a tube about ¼ an inch wide and 1¾ inches long. It shows the Fraunhofer lines very distinctly, and by holding a jargoon in front of the slit we have been able to detect the absorption bands of jargonium. Great credit is due to Mr. Ladd for this ingenious, useful, and very convenient form of spectroscope.

Royal Institution.—The following are the probable arrangements for the Friday evening meetings after Easter:—

April 9.—W. B. Carpenter, M.D., V.P.R.S., &c.; "On the Temperature and Animal Life of the Deep Sea."

April 16.—W. Carruthers, Esq., F.L.S., of the British Museum; "On the Cryptogamic Forests of the Coal Period."

April 23.—E. B. Tylor, Esq.; "On the Survival of Savage Thought in Modern Civilisation."

April 30.—Robert H. Scott, Esq., of the Meteoro-

logical Office; "On the Work of the Meteorological Office, Past and Present."

May 7.—Capt. Moncrieff; "On the Moncrieff System of Working Artillery."

May 14.—W. H. Perkin, Esq., F.R.S.; "On the Newest Artificial Colouring Matters."

May 21.—Professor H. C. Fleeming Jenkin, F.R.S.; "On the Submersion and Recovery of Submarine Cables in deep water."

May 28.—J. Norman Lockyer, Esq., F.R.A.S., M.R.I.; "On Recent Discoveries in Solar Physics made by the Spectroscope."

June 4.—Professor Odling, F.R.S."

NOTES AND QUERIES.

Carbolic Paper.—Pagliari, an Italian chemist, has invented a kind of paper wherein carbolic acid is so thoroughly incorporated that the paper, when used to pack animal substances therein, preserves the same in a fresh state without salt or any curing whatever.

Odylic Force.—In the obituary notice of Baron von Reichenbach, in No. 480, vol. xix., of the CHEMICAL NEWS, it is stated he has investigated the supposed new *odylic force*. Can any of your subscribers give a list of his writings on this subject, or those of any other author who has written on the same subject in French, German, or English?

On some New Products Obtained from American Petroleum.—Lefebvre has found therein a substance which boils at 23° C., and the composition of which is expressed by C_6H_8; the specific gravity of this liquid is 0·613, the vapour density is 1·60; with hydrochloric acid it forms propyl-chlorhydric ether. The residue of the rectification of these kinds of petroleum yielded hydride of butyl, C_8H_{10}, which boils at 0° C., and has a specific gravity of 0·624.

Vanilline.—Mr. Gobley has instituted researches concerning the odoriferous principle of vanilla. He found a substance therein which crystallises in long colourless needles; to the taste this substance was aromatic and hot; it does not affect litmus paper, fuses at 70° C., volatilises at 150° C., is nearly insoluble in cold, somewhat more soluble in hot water, and very soluble in alcohol, ether, and votatile as well as fatty oils. Its composition is expressed by $C_{30}H_8O_4$. Gobley calls it *vanilline*.

Action of Heat on Tartaric Acid.—Dr. Sace has heated tartaric acid in a large glass retort, taking care that not a particle of the acid was carried over mechanically during the process of distillation. He obtained in the receiver a very acid, nearly colourless, very mobile liquid, which turned out to be acetic acid; there was left in the retort a carbonaceous mass, while carbonic acid was given off. According to the author, it is possible that tartaric acid is a double acid made up of oxalic and acetic acids.

Hydroxyl.—Would you be good enough to inform me what is the nature and properties of "hydroxyl?" This substance is one with which candidates in the coming examination of the Department of Science and Art are expected to be acquainted with. I for one never heard of it before, and a search I have made to find it even mentioned in either Watts's "Dictionary" or in Miller's and Roscoe's books has been unsuccessful.

[Hydroxyl is another name for peroxide of hydrogen. It is supposed to act as a compound radical, equivalent to the simple radical chlorine. —*Ed. C. N.*]

Drying Green Wood.—A new method for drying green wood in a short time consists in boiling it for some hours in water, then leaving it to cool, next boiling it in an aqueous solution of borax, whereby the insoluble albumen of the wood is rendered soluble and escapes from its pores. The wood is then dried in chambers heated by steam, and left therein for three days. Wood so treated is more compact than it would be by ten years' exposure to air; it is far more secure against decay, does not shrink nor warp, and is more easily polished, on account of its having obtained by this treatment a more dense structure.—*Builder*.

On the Soluble Hydrates of Carbon met with in Fruits.—Commaille asserts that the saccharine materials met with ready formed in fruits, and also the substances which are capable of becoming saccharine matter, are far more varied than is usually supposed; in melons and parsnips Commaille, while testing the juice of these fruits at divers periods of maturity and development, found sometimes saccharine substances capable of left-handed polarisation, sometimes substances endowed with right-handed polarisation, sometimes he found levuline, and at other times substances as yet either entirely unknown or imperfectly described; he comes to the conclusion that the various substances met with in fruits are always in a state of change.

Positive or Negative?—Will one of your numerous readers be so kind as to inform me which is the *positive* and which the *negative* end of a voltaic battery? Miller, in vol. i., p. 577, says the zincode is the same as the anode, or positive pole, and that here we have O, Cl, and acids, which therefore must be electro-negatives. The platinode is said to be the same as the cathode or negative pole, and that here we get H, metals and the alkalies (electro-positives). In Lardner's "Handbook of Electricity," edited by Foster, p. 104, the zinc end is marked negative, and the copper positive. Ganot, in his "Physique," 7th edition, 1857, p. 596, says "Le pole positive est toujours à l'extremité vers laquelle les zinc de chaque couple sont tournés; et le pole negatif à l'extremité vers laquelle sont tournés tous les cuivres." All this is sufficiently puzzling, but on referring to an old edition of Golding Bird (1854), p. 341, he says that both O and H, together with N, S, P, Cl, &c., are electro-negative elements. If O is given out at one end, and H at the other, how can they both be electro-negative?" Again, he says (p. 344), "the positive current passes *from* the copper to the zinc plate." Other writers say exactly the reverse. If any one would put this matter in a clear light, the medical students of this country ought to vote him (I don't say they will) a piece of plate (not electro).—A MEDICAL STUDENT.

On Some of the Changes Pitcoal Undergoes when Heated.—Dr. E. Richter records some curious phenomena concerning coal when submitted for some time to heat. He took coal, reduced it to powder, and dried it in the cold over sulphuric acid until it ceased to lose weight; the coal was then heated to a temperature of from 180° to 200° C.; after having been submitted to this heat, even for a short time, an increase of weight was found to have taken place; this increase in weight was observed to go on until, after twenty hours, it reached its maximum, since, if the heating were continued after that time, a decrease of weight wes observed. The coal, the weight of which had increased, was found to differ from the coal originally taken in the following particulars:—Its outward physical appearance is not perceptibly altered, but it has increased in specific gravity, its chemical composition is changed, it behaves in a peculiar manner when coked in a covered crucible, and it has obtained increased faculty of attracting water from the air. Even when the coal originally taken and dried under a desiccator belonged to the caking coals, after heating it does not cake any longer, but behaves as a non-caking coal when ignited in a close crucible. When submitted to destructive distillation, the first products which come over into the receiver shows, in a very remarkable degree, a reddening of blue litmus paper, while no tar is produced at all. When 2 grammes of the previously heated (to 180° or 200°) coal were left exposed on a watch glass, even to a rather dry atmosphere, it was found that, after fourteen and thirty-six hours' exposure, the increase in weight was respectively 3·3 per cent and 4·8 per cent, when exposed in a drying stove to a temperature of 105° C. for a quarter of an hour, the original weight was restored again. As regards the chemical composition, it was observed that the previously heated coal differed from that dried under the desiccator by a loss of carbon and hydrogen and an increase of oxygen and nitrogen.—*Abridged from the Deutsche Industrie Zeitung*.

MEETINGS FOR THE WEEK.

MONDAY, March 22nd.—Medical, 8.
—— Royal Geographical, 8½.
—— London Institution, 6.
WEDNESDAY, 24th.—Geological, 8.
THURSDAY, 25th.—London Institution, 6.

TO CORRESPONDENTS.

*** With this number is given a separate sheet containing a portrait of the late Professor Faraday and a *fac simile* autograph.

G. H. Ogston.—Messrs. Rees and Co.'s letter renders yours unnecessary. The correspondence on the subject of Biphosphated Peruvian Guano had better cease now.

Subscriber.—The fullest details are given in Fresenius's "Quantitative Analysis."

H. Smith.—Hofmann's Exhibition Report is not to be had. You might see a copy in some library.

E. Baguley.—We regret that we are unable to supply the information.

York.—No trustworthy details have been published.

S. C. C.—You will find the papers referred to in one of our recent volumes.

Communications have been received from H. C. Sorby, F.R.S.; Professor Church, M.A.; E. P. H. Vaughan; Professor Gustavus Hinrichs (with enclosure); Townsend and Adams; S. C. C.; P. S. B.; J. Spiller; T. Hill; M. A. Baines; S. E. Philips; York; Chromo; W. H. Walenn; W. Mattieu Williams; J. Pattinson; H. Smith; H. C. South; Edwin Smith, M.A.; G. Baguley; E. V. Blackwell; G. H. Ogston; Muspratt Bros. and Huntley; Rees and Co.; Herrings and Co.; Dr. Aloin Pflughaupt; A. Casartelli; R. J. Reynolds; P. Curie; J. Wilkinson and Co.; F. E. S. Jerningham; A. Gibbs; T. Felton; D. Evans (with enclosure); Groombridge and Sons; S. M. Harrison; F. S. Sillitoe; J. Walch; A. N. Palmer; R. Schenk; T. Watts; W. Mackenzie; Mawson and Swan; R. Lavender (with enclosure); C. Cochrane (with enclosure); P. Holland; C. M. King (with enclosure); Sir Charles Wheatstone, F.R.S. (with enclosure); The Astronomer-Royal; Miss Bunvill; The Radcliffe Observatory; and J. W. Slater (with enclosure).

BOOKS RECEIVED.

The Medical and Surgical Reporter, vol. xx., Nos. 1 to 7. Philadelphia and New York.

Breathing considered in relation to the Bodily, Mental, and Social Life of Man. By Thomas Robinson. Glasgow: John Thomson.

Notes on the Alcohols from Coal Tar, and on Rhubarb. By E. R. Squibb, M.D. Philadelphia: Merrihew and Son.

Facts and Fallacies Discussed in a Series of Letters Written with reference to a Constant Service and a Future Source of Supply of Water. By John Taylor, C.E. London: E. and F. N. Spon.

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Hydrostatics,	Heat,	Electro-Magnetism,
Hydraulics,	Light,	Magneto-Electricity,
Pneumatics,	Magnetism,	Thermo-Electricity,

This Catalogue includes the Apparatus that was recommended for use in Elementary Schools, in the Report addressed to the Committee of Privy Council, By the Rev. Dr. TEMPLE, formerly Her Majesty's Inspector of Schools, and now Head Master of Rugby School.

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Vol. II., price 21s.

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Vol. III., on Food, Sugar, &c., is at present out of print.

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Extracts from the Report of the Directors, presented at the Annual General Meeting held on the 27th November, 1868:—

1. The sum of £412,345 was proposed for Assurance, of which £307,395 was completed, at Premiums producing £10,067 per Annum.
2. The amount paid under Claims by death was £100,883. being the smallest since 1860, whilst the expenses of management and all other outgoings were even less than for many years past.
3. On the other hand, the Income was raised to £219,769, notwithstanding that its increase was retarded by abatements of premium which did not take effect in the previous year, and by the cessation of interest on the large sum paid as Bonus in 1867.
4. The Surplus income was very considerable. It amounted to £93,152, a sum exceeding by more than £8,000 any previous Surplus during the forty-four years of the Society's existence.
5. The Accumulated Fund was thereby increased to £1,598,906.

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Mr. J. C. BRAITHWAITE, for thirteen years Principal Instructor in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c., wishes to inform his old Pupils and others that he continues to devote his whole attention to Education.

The Session 1868—1869 will commence on the 1st of October, when Mr. BRAITHWAITE'S Laboratory, which has been enlarged, will be re-opened at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS meets as usual every Monday and Thursday Evening, at 8 p.m., commencing October 1st.

The LATIN CLASS for the reading of the Pharmacopœia, Physicians' Prescriptions, &c., every Tuesday and Friday Evening, at 8 p.m., commencing October 2nd.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday Evening, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday until further notice.

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Liebig Company's Extract of Meat.—Paris and Havre Exhibition Gold Medals. CAUTION.—None genuine without Baron Liebig's (the inventor) signature being on every jar, accompanied by full printed directions. About 70 Pints of excellent beef tea for 11s., the present reduced retail price per pound. Finest, most convenient, and by far the cheapest meat-flavouring ingredient for soups, made dishes, and sauces. Sold by all Italian warehousemen, chemists, grocers, ship chandlers, and provision dealers. Retail, of all Italian Warehousemen, Chemists and Grocers. Wholesale, of Crosse and Blackwell; E. Lazenby and Sons; John Burgess and Son; Barron, Harveys, and Co.; Barclay and Sons; Burgoyne, Burbidges, and Squire; Wm. Edwards; M. E. Foster; Langtons, Scott, and Edden; S. Maw and Son; G. S. Pedler; T. & H. Smith & Co., London & Edinburgh; Duncan, Flockhart, and Co.; John Mackay; H. C. Baildon, Edinburgh, Southall, Son, and Dymond, Birmingham; Wm. Smeeton, Leeds; Raimes and Co., and B. Westworth, Liverpool; Mottershead and Co., Manchester; W. Proctor and Son, Newcastle-upon-Tyne; all Wholesale Houses, and of Liebig's Extract of Meat Company Limited), 43, Mark Lane, E.C.; Francis Newbury and Sons, London; and James Woolley, Manchester.

The Royal Polytechnic.—Last Lectures on ASTRONOMY, by Professor Pepper, Monday, Wednesday, and Thursday, at 3 and 7.30. Subject:—"The Sun, and Discoveries of Norman Lockyer, Esq." Mr. J. Browning's Observations of an enormous Train of Sun Spots, also of the remarkable Lunar Craters of Aristarchus and Linné. All the Entertainments and Lectures as usual. NB.—Great preparations are being made for the Easter Holidays.

THE CHEMICAL NEWS.

Vol. XIX. No. 486.

ON THE CHEMICAL CHANGES OF CARBON.

A COURSE OF SIX LECTURES*

(Adapted to a Juvenile Auditory),

DELIVERED AT THE

ROYAL INSTITUTION OF GREAT BRITAIN,

(CHRISTMAS, 1868-9),

BY

WILLIAM ODLING, Esq., M.B., F.R.S.

(Fullerian Professor of Chemistry in the Royal Institution).

LECTURE VI.

(Concluded from p. 136).

Carbonic Disulphide—Carbon—Carbonous Oxide—Carbonic Gas.

And now we pass on to the consideration of an entirely different section of our subject. You will remember that ordinary charcoal is obtained from wood. When wood is strongly heated or burnt in a limited supply of air, the carbon of the wood scarcely burns at all, and we have this carbon preserved to us in the form of charcoal. Charcoal, then, is the chief constituent of wood, in which substance it exists in the unburnt condition; and not only does charcoal exist in wood, but in nearly all vegetable substances. The seeds of wheat contain starch, in which charcoal exists; sugar, too, contains a considerable proportion of charcoal, and when these substances are burnt they leave a great deal of charcoal behind. Here, for instance, we have some wood shavings. Now I can very readily show you the charcoal in these wood shavings by pouring upon them a little of that very corrosive substance called oil of vitriol. By letting this liquid act upon the shavings for a little time they quickly change into a mass of black charcoal. In the case of such a substance as sugar, the action takes place still more rapidly. Here in this large cylinder are some pieces of sugar; I moisten them with a little hot water, and then pour some oil of vitriol upon them, and you observe that when I do so the sugar is at once converted into a mass of black charcoal. [The sugar became rapidly charred by the sulphuric acid, and the admixture emitted steam, and swelled into a black spongy mass, overflowing the glass jar in which the experiment was performed, and which, in the first instance, was not more than one-third full.]

All these substances which I have mentioned to you as containing carbon, burn very readily into burnt carbon or carbonic gas. If, for instance, I burn a piece of wood in a small tube of oxygen, you will find that a brilliant flame is produced, and the result will be the formation of carbonic gas, which is proved by the application of the lime-water test.

Instead of burning the charcoal directly in oxygen gas, as I have done in two or three previous experiments, I am now going to burn it in a substance which contains oxygen gas; and it shall be burnt under water and the carbonic gas which is produced collected in a cylinder. [A mixture of nitre and carbonaceous matter was burnt in a tube under water.] You see that, in this way, our cylinder which was full of water is now becoming full of burnt charcoal or carbonic gas. I cause some of the gas to bubble up through lime-water, and you see the lime-water becomes converted into a mixture of chalk and water, proving that we really have produced gas of this kind. I will now collect some of the gas in a separate vessel, and again show you its nature by its property of extinguishing flame.

Now, if you reflect a little, I think you will come to this conclusion,—that substances which grow, vegetable substances, are all of them destined ultimately to become burnt, or to undergo a change equivalent to burning. A great deal of wood, for instance, is chopped up and used for fire wood; a great deal more is used for building ships, for forming the interior portions of houses, and making furniture. These ships and houses and furniture last for a certain time; they gradually pass from an honourable into a dishonourable condition; old furniture is put into the lumber room; the disabled ships are broken up and destroyed, and at last they go to the fire, where the carbon becomes oxidised or converted into carbonic gas. But there is a great deal of vegetable matter which never undergoes this burning. In the autumn a large quantity of leaves fall to the earth and there undergo some sort of change; this change is, in fact, a very slow burning, but without the phenomena of ignition which we see in the case of a fire, although the leaves are converted into carbonic gas or oxidised carbon. Now here is a bottle which contains some decaying wood, and, as I showed you in the last lecture, a lighted taper introduced into the bottle is at once extinguished by the burnt carbon or carbonic gas, which has been produced by the oxidation of the wood in the process of decay. Here, again, is some rotting sawdust; this also gives rise to carbonic gas, which extinguishes a lighted taper introduced into it. You see, therefore, that although the wood does not actually undergo

* Reported verbatim, by permission of the Author, for this Journal.

the process of burning, as we are accustomed to see it, it does undergo the process of decay, which is a conversion of the original carbon into burnt charcoal. But a great quantity of vegetable substance neither undergoes burning nor decaying, but is eaten. We know that cattle feed largely on corn and straw, and we ourselves consume much wheat and other grain. In these instances, although the vegetable substances do not, strictly speaking, *decay*, yet they undergo another form of the process of oxidation, by which burnt charcoal is produced. For example, if we take a little lime-water, and blow, or rather breathe, through it, we have evidence of a considerable amount of burnt carbon being present in the breath. In this case, the carbon, instead of having been burnt in a furnace, has simply been burnt in our bodies, thereby rendering our bodies warm, just as when it is burnt in the fire it warms a room. In order to show you the presence of carbonic gas in the breath, it will be quite sufficient for me to breathe into a bottle of lime-water. Here is one—I breathe into it, close it, and shake it up, and by that simple act I have, as you see, produced a very considerable quantity of chalk, showing the presence of carbonic gas, or burnt carbon.

All vegetable tissue, then, comes sooner or later to be burnt, or oxidised, or converted into carbonic gas.

The next point which I should like you to notice is the *unburning* of carbonic gas. How is it possible to do this? On this subject I must just call your attention to what is here written upon the diagram :—

$$\left.\begin{matrix}\text{Carbon}\\ 2\ \text{Oxygen}\end{matrix}\right\}\ \text{Carbonic gas.}$$

$$\left.\begin{matrix}\text{Carbon}\\ 1\ \text{Oxygen}\end{matrix}\right\}\ \text{Carbonous oxide.}$$

Carbonic gas is really a combination of one proportion of carbon and two proportions of oxygen. Now there is another oxide of carbon of which I have not yet spoken, which consists of one proportion of carbon and one of oxygen; it is called carbonous oxide. If I take carbonic gas and half unburn it, I remove one-half of the oxygen, and the result is carbonous oxide. How is this done? Well, one way is by burning something in carbonic gas. If you take one of the few substances that will burn or oxidise in carbonic gas, you will find that that substance by its burning will take away some of the oxygen from the carbonic gas, and thereby convert it into carbonous oxide. One of the commonest forms of this experiment is to take some carbonic gas and pass it through a tube filled with red-hot iron. Under these circumstances, the iron takes away some of the oxygen, or unburns the carbonic gas down to carbonous oxide; but I am about to show you a more convenient form of the experiment, and one for which I am indebted to Dr. Taylor.

I take, not metallic iron, but metallic magnesium, and I will show you that, although a taper is extinguished in the carbonic gas, yet the magnesium will burn. I introduce a piece of ignited magnesium, and it continues to burn in the carbonic gas. You see that a taper, when introduced into the same gas, is extinguished, whilst the light of the magnesium, under the same circumstances, is so brilliant that it almost blinds one for the moment. Now when this metal—magnesium—burns in this way it reduces, or decomposes, or unburns, the carbonic gas to the state of carbonous oxide; but there are some metals, you will remember, which go beyond that. When a piece of sodium is burnt in carbonic gas, it not only unburns the carbonic gas to the state of carbonous oxide, but it takes away all the oxygen and reduces the carbonic gas again to a piece of charcoal. By means of the magnesium, we unburn the gas by taking away one proportion of oxygen, and reducing it to a compound which contains one proportion of oxygen and one of carbon; but when sodium is used, the two proportions of oxygen are taken away and the carbon left free.

Here is a vessel generating carbonic gas in the usual way. The gas is being conducted into this glass globe, and it is there made extremely hot by the action of the electric spark. An intense degree of heat is produced, and, under these circumstances, the carbonic gas breaks up into a mixture of carbonous oxide and oxygen. Now for this purpose we do not necessarily require the heat of the electric spark. Even the heat that we can obtain by the combustion of a flame of ordinary gas in a current of oxygen is quite sufficient for our purpose. I have here a supply of coal gas; I pass oxygen into its flame, and with this flame I will heat a platinum coil. I now allow the carbonic gas to pass through the heated platinum coil, and in its passage the carbonic gas is decomposed into carbonous oxide and oxygen. To give you some idea of the amount of heat which can be produced in this way, I will hold in front of the blowpipe flame a plate of iron. You see that, although this plate is one of considerable thickness, it is utterly unable to withstand the high degree of heat which I am in this way applying to it. [Holes were burned in the plate of iron at those points on which the flame was allowed to impinge.]

When our carbonic gas is subjected to this extreme degree of heat, it undergoes decomposition—not into carbon and oxygen, but simply into carbonous oxide and oxygen. It only becomes one-half unburnt. Now are there any agencies in nature by which this carbonic gas can be com-

pletely unburnt? There is one, and one only, that is, through the influence of vegetation under exposure to the sun's rays. If, in the spring time, when the sun is shining, we take some rapidly growing plant—for instance, a sprig of mint, which answers the purpose very well—and immerse it in a vessel of water which is charged with carbonic gas, that carbonic gas will undergo an unburning; its oxygen will gradually bubble up from the leaves of the plant, and rise to the top of the vessel of water; but what will become of the carbon? It will be converted into starch and wood and sugar and other substances, which go to form the living plant. By this means only can the carbonic gas be unburnt into carbon, which goes into the tissues of the plants, and into oxygen, which is given off again into the atmosphere.

Now what is the point of interest in an unburning of this kind? If I were to allow an electric spark to pass through the air it would give out a certain amount of heat, but, on passing through the carbonic gas, it emits a considerably less amount. Well, what has become of the difference? It has gone somewhere. If I take this mixture of carbonous oxide and oxygen, produced from the carbonic gas by the passage of the electric spark, and set fire to it, it gives out exactly the amount of heat that disappeared from the heat of the spark. In that case, the carbonous oxide and the carbon burn together. I will give you an illustration of the combustion of these two substances. Here is a large cylinder of the half unburned carbonic acid; I set fire to it, and you see the curious blue flame which it emits and the peculiar manner in which it burns. I have also some of the carbonous oxide burning from a tube, and if I hold over its flame an empty bottle, I shall be able to collect the burnt carbonic gas which is so produced. You see the beautiful blue flame which the carbonous oxide sends out from the tube. I may also show you the considerable amount of heat which it gives out in burning. If I introduce into the flame a piece of platinum wire you see it immediately becomes very red, showing the flame to be exceedingly hot. Now when I burn together the carbonous oxide and the oxygen, which have been separated from one another, exactly the same amount of heat is given out by it that was absorbed from the electric spark by the products of the unburning of the carbonic gas, and was not used in heating the surrounding air.

Now, if the sun, instead of shining on the plants which grow on the earth's surface, were to shine entirely upon the stones, it would heat the atmosphere a great deal more than it does. As it is, a portion of the sun's heat disappears. What, then, becomes of it? It is absorbed by the vegetation. The amount of heat absorbed by a growing piece of wood in unburning the carbonic gas of the atmosphere into charcoal and oxygen, is exactly the amount which the piece of wood is capable of giving out when its carbon is re-burned in the air; and, accordingly, when we burn coals, or wood, or peat upon our fires, or consume bread, and oil, and wine in our bodies, and thereby produce a considerable amount of heat either in the fires or in our bodies, we are really manifesting once more, in the form of heat, the sun's rays, which years and years before shone upon the plants from which those substances were derived. We are getting back the sun's heat, which was originally absorbed by the growing plants. When we burn any one of these substances we recover from them the sun's heat which disappeared in their growth. We will here burn some sugar, and we shall be able to regain very easily an exhibition of the sun's rays that were absorbed in separating the carbon of the sugar from the oxygen with which it was in combination, and which, upon being separated, was discharged into the air. I pour a drop of this liquid upon the mixture of sugar, and you see the very brilliant evolution of the sun's rays which were bottled up in the formation of the sugar.

And now it only devolves upon me to thank you heartily for your kind attention during these lectures. I hope, that whenever again you see a piece of coke, or a piece of charcoal, or a piece of marble, or a growing plant, you will remember the curious relations of change which exist between them, and how the one is capable of being converted into the other.

ON THE

IMMEDIATE ANALYSIS OF DIFFERENT VARIETIES OF CARBON.

By M. BERTHELOT.

(Continued from page 137).

II. Influence of Sundry Agents upon Carbon already formed, as Heat, Chlorine, Iodine, Oxygen, and Electricity.

1st. I did not succeed in passing from one group to the other under the influence of heat alone—that is, by calcining graphites and amorphous carbons at a white heat in an atmosphere of hydrogen. The amorphous carbon only appeared to augment in cohesion, whilst pyrographitic oxide, after calcination, does not yield more graphitic oxide than before.

2nd. Chlorine, at a white heat, does not change either wood charcoal into graphite or graphite into amorphous carbon; free carbon is well known to be unaffected by it. Iodine, at a white heat, does not change coke into graphite, it does, however, produce this transformation in nascent carbon at a red heat.

3rd. The action of oxygen causes simultaneously an extreme elevation of temperature, and the formation of carbonic acid and oxide of carbon. Carbon submitted to this double influence may be examined by lighting, at a

jet of oxygen, a pencil of retort charcoal, previously heated to redness. Whilst the point is in full incandescence, it must be quickly plunged into cold water to extinguish it; the extreme end of the pencil is then detached, taking only that part which has been most thoroughly heated. The carbon thus treated does not consist entirely of amorphous carbon, but also contains a small quantity of graphite, formed under the double influence of heat and oxidation. The same influences prevail in the case of incomplete combustion, when lampblack is formed; in this I have observed the presence of a trace of graphite; the occurrence of a similar trace of graphite in certain cokes is attributable, in my opinion, to the same cause.

These different results merit the more attention as it is possible that analogous phenomena may have played some part in the natural formation of graphite. To a similar origin has been attributed until now the formation of graphite and anthracite; but the result of my observations is, that the spontaneous decomposition of organic remains, even with the assistance of red heat, would furnish no plombagine. The origin of the latter requires special explanation.

I have also examined the poles of carbon employed for the transmission of electric light. The powdered carbon, obtained by scraping a number of charcoal pencils which had formed the negative poles in producing electric light, was subjected to oxidation, and large quantities of graphitic oxide were thus obtained. This latter, and consequently electric graphite also, are identical with, neither those of cast-iron nor of plombagine.

The change which is here produced in the amorphous charcoal of gas retorts may also be seen in diamond. M. Jacquelain has demonstrated that diamond placed in the voltaic arc changes into a sort of coke. I was enabled to examine the same specimens which had been used in former experiments at the Sorbonne: the carbonaceous matter which had undergone oxidisation was changed into graphitic oxide of the same kind as that of the charcoal from the retorts.

It was, therefore, probable that charcoal which had undergone the action of the voltaic arc would contain no diamond; this I carefully ascertained to be a fact, operating on considerable quantities of matter. None of the specimens (obtained from the experiments made by Despretz upon sugar charcoal, with a pile of 600 elements) contained the least trace of diamond.

The formation of electric graphite does not occur indifferently at either of the electric poles. The negative poles only thickened by the passage of the carbon, furnish a large quantity of graphitic oxide, whilst the corresponding positive poles, thinned by the same phenomenon, contain only traces, which are probably due merely to the necessarily imperfect separation of carbon during the act of electric illumination. Transformation into graphite does not, however, require the previous volatilisation of the carbon; finally, capsules of sugar charcoal, softened by the heat of a pile of 600 elements, were found to be for the most part changed into graphite at the negative pole.—*Comptes Rendus.*

ON THE SUBSTITUTION OF SODIUM FOR PHOSPHORUS IN LUCIFER MATCHES.

Dr. H. Fleck, of Dresden, has instituted a series of experiments with the view to obtain a non-poisonous paste for the application to lucifer matches. He ascertained, by some preliminary experiments, that sodium, when minutely divided along with explosive substances, becomes highly inflammable when simply moistened with water. A mixture, constituted according to the formula—

$$(KO,NO_5)+Na+2C=(KO,CO_2+NaO,CO_2)+N,$$

formed a greyish-coloured mass, which, on being touched with a moistened glass rod, ignited like gunpowder; this mixture was, however, found to be unfit to ignite ordinary brimstone matches for a cotton wick soaked in petroleum. In order to mend this defect, black sulphuret of antimony was substituted for the charcoal, according to the formula $3(KO,NO_5)+Na+(SbS_3)=(NaO,SbO_5)+3(KO,SO_3)+3N$, and the mixture made up of—

0·5 grammes of sodium	=	4·65	per cent
66·0 ,, nitrate of potash	=	61·39	,,
36·5 ,, sulphide of antimony	=	33·96	,,

Provided that during its manufacture this mixture is kept thoroughly dry, it has been found to answer admirably well. The mode of making it up is briefly as follows:—Pure solid paraffin is put into a well-stoppered glass flask, and melted over a sand bath, when fluid, clean pieces of sodium are added, and liquefied under the paraffin. As soon as the metal is thoroughly liquefied, the flask is closed and shaken for about ten minutes, which has the effect of granulating the metal, or rather reducing it to a fine powder. The metal is then poured out of the flask along with the paraffin, and the sodium taken out of the paraffin by means of a clean dry spoon; from 30 to 35 per cent of paraffin remains adhering to the metal; this, however, does not impair its inflammability, while it tends to preserve the metal. Owing to this increase, instead of 5 grammes, 6·6 grammes of the metallic powder thus obtained must be weighed off. The incorporation with the other ingredients, previously well dried and warm, is effected under petroleum in metallic mortars, but each of the substances is first mixed with some petroleum, and pulverised separately before being triturated with the sodium; instead of gum or glue, caoutchouc, previously soaked in light petroleum oil at 110° C. for ten or twelve hours, is used as mass to form an adhesive paste with the other materials. According to several accounts from Germany, this plan of substituting sodium for phosphorus has been favourably taken up by some of the largest and leading manufacturers of lucifer and fusee matches. There is said to be not the least danger in the transport. —*Abridged from Deutsche Industrie Zeitung.*

ON THE PRESERVATION OF TIMBER.*

By P. M. MOIR.

The preservation of timber is of great practical importance—its preservation is alike valuable to the student, the practical worker, and the capitalist; and it is not to be wondered at that many minds have been directed to solve the question whereby decay may be arrested, and the timber preserved and made as durable as the other parts of the construction it may be in union with.

A very common and destructive kind of decay is dry rot, which is often very rapid in wasting the substances of timber, more particularly in such places as are free from a circulation of air.

There is another familiar agent deadly to timber, which we in this country are not acquainted with, but which is the cause of great destruction in India, Ceylon, Brazil, and all tropical countries, where it is very abundant. I refer to the white ant, or termite. Its attacks are most ravenous on all wood buildings, railway sleepers, and bridges, although the material used in the latter be of *lignum vitæ*, a very hard and durable wood.

Timber used for marine purposes is subject to the attacks of the *Teredo navalis* and *Limnoria terebrans*. Greenheart timber, in its natural state, is the only wood now in use for harbour works that is free from the attacks of marine worms and insects, and the white ant in tropical countries.

There are two reasons why this timber resists the ravages of these insects—1st, its hardness; 2nd, it contains a large quantity of essential oil.

* Abstract of a paper read before the Glasgow Philosophical Society (Chemical Section), Feb. 1, 1869.

I now come to the various methods that have been adapted and tried for the preserving of timber, both from natural decay and destruction, mentioned—and these have been mechanical and chemical.

The mechanical have been wholly applied for marine purposes, and are the oldest in use. The first, I may mention, consisted in covering piles, between high and low-water mark, with flat-headed iron nails, the heads being about 1 inch in diameter, driven into the wood as close to one another as they could be put without overlapping; the water soon acted upon them by corrosion, which penetrated the skin of any portion of the wood not covered by the nails. This process is very expensive, not only in the materials used, but the amount of labour required driving in the nails.

Another plan was to cover the piles with sheets of zinc or copper.

I next come to the chemical processes that have been tried, and are still in use, for preserving wood.

Upwards of fifty patents have been taken out for preserving animal and vegetable substances, including timber, many of which have never been worked practically; in fact, there are only six that I am acquainted with that have been worked commercially—Kyan, 1832; Margary, 1837; Bethell, 1838-48; Burnett, 1838-40; Payne, 1841-46; Boucherie, 1839.

These patents were obtained for the application, either by steeping or filling the pores of timber by pressure in close vessels with solutions of different chemical agents; excepting Boucherie's, and he latterly adopted the salt used by M. Margary—viz., the sulphate of copper.

PATENTS.

Kyan ..	1832	Chloride of mercury.
Margary	1837	Sulphate of copper.
Bethell ..	1838 1848	Creosote, or pitch oil.
Burnett ..	1838 1840	Chloride of zinc.
Boucherie	1839	Pyrolignite of iron.
	1846	Sulphate of copper.
Payne ..	1841	Sulphate of iron.
	1846	Carbonate of soda.

In the working of these patents practically, there were three different methods used in the application—viz., steeping, vital suction, and pressing in close vessels. The first of these was adapted by Kyan and Margary, the second by Boucherie, and the third by Payne, Burnett, and Bethell, and latterly by Boucherie. In the first and third methods, the several processes required the timber should be seasoned and free from sap.

Kyan's process was the mixing of chloride of mercury, in proportion of 1 lb. of salt to 5 gallons of water.

Margary, in 1837, obtained a patent for preserving timber, ropes, canvas, cloth, &c., by soaking them in a solution of sulphate of copper.

Payne, in 1841, obtained patent rights for a process for preserving timber. His plan was the production of a double decomposition in the pores of the wood, by first injecting a solution of some metallic body, such as sulphate of iron, which was forced into the wood under pressure in iron cylinders; after the wood had absorbed the quantity required, the surplus liquor was drawn off, and a solution of carbonate of soda forced in, which fixed the iron in the cellular tissues of the timber, forming oxide of iron.

Sir William Burnett took out a patent in 1838 and in 1852; the latter was an extension of his patent rights for seven years. His patent was for the preservation of timber, canvas, cordage, cotton and woollen cloths, &c., with a solution of chloride of zinc (ZnCl), the proportion used being 1 gallon of the concentrated solution to 40 gallons of water.

I have now to bring before your notice the last of these patents—viz., Bethell's process for preserving timber with creosote, or pitch oil. This invention differs entirely from all the others, in so far that the oil used is not only a most powerful coagulator of albumen, but it likewise preserves the fibre of timber. Of all processes for preserving timber, this one seems to have found most favour, as it has been universally used, not only in Great Britain and Ireland, North and South America, India, and all continental countries in Europe, wherever railways have been constructed, but also in harbour works, for which it is especially applicable in resisting the attacks of marine worms and insects. Many patents have been obtained for the use of oleaginous substances in preserving timber, but none were brought into practical use until Bethell procured his in 1838. In some instances cylinders are open at both ends, and closed with iron doors, so that sleepers or timber entered at one end, on being treated, can be delivered finished at the opposite end. I have found, however, for all practical purposes that one open end is sufficient, as the oil when heated, being of such a searching character, it is a difficult matter to get the doors perfectly air-tight, consequently they are apt to leak during the time the pressure is being applied. Pipes are led from the cylinder to the air and force pumps; the air is not only extracted from the interior of the cylinder, but also from the pores of the timber. When a vacuum is made, the oil, which is contained in a tank below the cylinder, is allowed to rush in, and as soon as the cylinder is full, the inlet pipe is shut and the pressure pumps started, to force the oil into the wood; the pressure maintained is from 150 to 200 lbs. to the square inch, until the wood has absorbed the required quantity of oil, which is learned by an index guage fixed to the working tank below. All cylinders are fitted with safety valves, which allow the oil not immediately absorbed to pass again into the tank. The oil is heated by coils of pipe placed in the tank, through which a current of steam is passed, from end to end, raising the temperature to 120° F. The quantity of oil recommended by the patentee, engineers, and others, is 8 lbs. of oil for land purposes, and 10 to 12 lbs. to the cubic foot for marine. In this country, for marine the quantity does not exceed 12 lbs.; but on the continent—in France, Belgium, and Holland—the quantity used is from 16 to 26 lbs. per cubic foot. Beech has absorbed as high as 31 lbs. of oil per cubic foot, and when used for planking, either for railway platforms or harbour works, is, without doubt, the cheapest and most durable material that can be used.

I estimate the possible yield of pitch oil in Scotland at 1,000,000 gallons; this is mostly all used for creosoting purposes; latterly a portion has been applied for fuel burning under steam boilers. It is slightly soluble in water, consequently it could not be used for out-door purposes in its pure state; it requires to be mixed with oils, or the other portions of the creosote, which fill up the pores of the timber, which, on exposure to the air, solidifies, giving the wood a coating, and making it impervious to water and the action of the atmosphere.

In the new edition of Dr. Ure's "Arts and Manufactures," under the head of "Wood Preserving," it is stated that Bethell's process "produces perfect coagulation of albumen in the sap, thus preventing its putrefaction."

In a letter written by Dr. Letheby, extracted from the *Journal of the Society of Arts*, after describing the action that takes place when timber is prepared with creosote, he concludes his letter by stating that the preservative action is of four kinds:—

1st. It coagulates albuminous substances, and gives stability to the constituents of the cambium and cellulose of the young wood.

2nd. It absorbs and appropriates the oxygen which is within the pores of the wood, and so checks, or rather prevents, the eremacausis of the ligneous tissue.

3rd. It resinifies within the pores of the wood, and in this way shuts out both air and moisture.

4th. It acts as a positive poison to the lower forms of

animal and vegetable life, and so protects the wood from the attacks of fungi, acari, and other parasites.

The creosoting process since it was first introduced in 1838, has been extensively employed in Great Britain and Ireland, and in all countries on the continent of Europe where creosote oil can be economically procured; wherever it has been properly carried out, it has been completely successful.

Of late, many railway companies have discontinued the creosoting of their sleepers, not on account of any failure in the process itself, but from the wear and tear of the chair cutting down into them, and gradually rendering them useless. This would not have been the case, to a great extent, had the base of the chair been broader, which would have prevented the mechanical action of sinking into the wood, and enabled the sleeper to have lasted much longer.

In India, and elsewhere abroad, where damp, dry rot, and insects destroy unprepared sleepers so rapidly, I say by all means creosote; and for all soft wood timber used in the construction of piers, bridges, and similar works, I say the same. Creosoting being a preservative against the attacks of the white ants in India, great numbers of creosoted fir sleepers were sent out from England. These creosoted sleepers were found to be very durable. The fir wood itself is perishable in India, probably from the heat causing the turpentine, &c., to evaporate rapidly, but the creosote has the effect of preserving it, and of preventing the depredations of all kinds of insects, even when the wood is most exposed to their attacks.

In the report presented by the Minister of Public Works in Belgium, in May, 1863, to the Legislative Assembly, respecting the operations of the State Railways in the year 1862, at page 12 it is stated as follows:—

"In 1862 a special commission was instituted to determine the state of preservation of the sleepers, which, before being put into use, have been the object of preparations destined to prolong their duration. The result of this commission has been to persuade the Government to give up entirely the process Boucherie, and for the future to abide by the using—1st, of oak sleepers in their natural state, or which have been submitted to the preparation of the creosote oils by system Bethell; 2nd, of beech sleepers or red pine, prepared after the same process."

At page 86, a statistical table is published showing the numbers used between the years 1835 and 1863, in which table is stated that the average duration of unprepared oak sleepers is $11\frac{7}{1}$ years, and of unprepared fir slepers, 7½ years.

In the spring of 1865, a very careful examination was made by the authorities of all the creosoted sleepers, and they found that all these sleepers (although some of them had been in use 19 years) were perfectly sound and fresh, and, in consequence, the Belgian Government decided to have all their sleepers creosoted in future.

The annual Government report on the Belgian State Railways, for the year 1864, states:—

"123,397 sleepers, prepared by Mr. Bethell's process, were laid down; and 16,205 prepared by Boucherie's process (sulphate of copper); and 1,869 sleepers prepared by various other processes, were taken up.

"The administration, looking to the results of past years' experience, continues to confine itself to oak sleepers and creosoted sleepers for making or relaying its lines, as the superiority of Bethell's system over all others appears to be an established fact. Out of the 153,753 new sleepers put down in 1864, 128,165 were creosoted, and only 25,588 were unprepared oak."

For marine purposes it is the only process now acknowledged by engineers to be applicable for preserving timber from the attacks of the *Teredo* and *Limnoria*. For harbour works in Scotland this process has been largely used. At Leith, the west pier is entirely constructed of creosoted timber, consisting of 1013 main piles; the extension of the east pier also consists of 312 main piles creosoted. These erections were commenced in 1848, and finished in 1853, and at the present time they are all as perfectly sound as the first day they were put down. The gates of the new dock, now being constructed at that port are of creosoted pine bound with greenheart. The quantity of oil used was 10 lbs. per cubic foot. At Glasgow, all the wood-wharfs, with exception of the steam-boat quay, are constructed of creosoted pine, 8 lbs. of oil being injected to the cubic foot. The whole of the wharves at Kingston dock, are entirely of creosoted wood, the same quantity of oil being used. At Port Glasgow and Greenock, timber prepared by this process is largely used, and at nearly every port in England.

Of late, several other processes have been patented for preserving timber.

Robbins's is to put the timber into iron chambers, and passing the vapours obtained from the distillation of coal tar into the chambers, and allow the timber to absorb the same without pressure.

The Resin Process.—The timber is first boiled in a weak solution of carbonate of soda, and then treated with liquid resin in close tanks heated to 306°.

Beerziny's is another process, and, as described by the patentee, he removes the sap of timber by boiling in water to which borax is added.

ON FOOD.*

By DR. LETHEBY, M.A., M.B., &c.

(Concluded from p. 139.)

Unwholesome and Adulterated Food.

Of the second class of adulterations, where the object is to improve the appearance of the article, there are many examples, as:—

(*a*). The addition of alum to bread, by which, as I have already explained, inferior, and even damaged, flour may be made into a tolerable looking loaf. It is the property of alum to make the gluten tough, and to prevent its discolouration by heat, as well as to check the action of the yeast or ferment upon it. When, therefore, it is added to good flour, it enables it to hold more water, and so to yield a larger number of loaves; while the addition of it to bad flour prevents the softening and disintegrating effect of the yeast on the poor and inferior gluten, and so enables it to bear the action of heat in the process of baking. According to the quality of the flour will be the proportion of alum, and hence the amount will range from 2 oz. to 8 oz. per sack of flour. These proportions will yield from 9 to 37 grains of alum in the quartern loaf, quantities which are easily detected by chemical means. Indeed, there is a simple test by which much smaller quantities of it may be readily discovered. Infusion of logwood, as you here perceive, acquires a rich purplish carmine, or claret tint, when it is brought into contact with alum; you have, therefore, only to dip a slice of the bread for an instant, as I am now doing, into a weak, watery solution of logwood, and if alum be present the bread will speedily acquire a purple or reddish purple tint. I have already described to you the other properties of good bread, as that it should not exhibit any black specks upon the upper crust; it should not become sodden and wet at the lower part by standing; it should not become mouldy by keeping in a moderately dry place; it should be sweet and agreeable to both taste and smell; it should not give, when steeped in water, a ropy acid liquor; and a slice of it taken from the centre of the loaf should not lose more than 45 per cent by drying.

Sulphate of copper is found to act like alum in improving the appearance of bread; and, according to Kuhlmann, Chevallier, and others, it is commonly used by

* The Cantor Lectures, delivered before the Society of Arts.

the bakers of the Continent, notwithstanding the severe penalties attached to it. In this country, however, it is but rarely employed.

(*b*). The bloom, or glaze, or facing of green and black tea is generally artificial. In the case of green tea, it is ordinarily a mixture of Prussian blue, turmeric, and sulphate of lime, or China clay; and in that of black tea it is not unfrequently a coating of black-lead. The tea prepared for the English market is notoriously subject to these adulterations; and it seems that it arises entirely from our own fancy, and not from any desire on the part of the Chinese to pursue such a practice. The adulteration is easily discovered by shaking the tea with cold water, and then straining through muslin, and allowing the fine powder to subside.

(*c*). Pickles and preserved fruits are often made green with a salt of copper, it being the peculiar property of that metal to mordant, or fix in an insoluble form, the green colouring matter or chlorophyl of vegetables. If, therefore, the pickling operation is conducted in copper vessels, or if a little verdigris or sulphate of copper is added to the vinegar in which the vegetables are boiled, the colour of them will be retained. In some cases the quantity added has been so large as to give a coppery look to a steel fork or knife plunged into the pickle. In such cases, as might be expected, severe symptoms of poisoning have been occasioned by it.

(*d*). Ferruginous earth, or red oxide of iron, is frequently added to sauces, to anchovies, to cocoa preparations, and to preserved or potted meats, to improve their appearance.

(*e*). Mineral pigments, often of a poisonous nature, are used in colouring confectionery.

And lastly, with the view of giving a false strength to the article, we have instances of sulphuric acid added to vinegar, black-jack or burnt sugar to coffee and chicory, catechu or *terra japonica* to tea, *cocculus indicus* to beer, cayenne to peppers, &c.

That many of these sophistications are dangerous there can be no doubt, and all of them are frauds on the public. Parliament has therefore attempted to deal with the matter by legislation, as in the "Act for Preventing the Adulteration of Articles of Food or Drink" (23rd and 24th Vict., cap. 84) of 1860; but as the act is only permissive, little or no effect has been given to it. Even in those places, as in the City of London, where it has been put into operation, and public analysts have been appointed, no good has resulted from it; in fact, it stands upon the statute-book as a dead letter. Speaking for the City, I may say that every inducement has been offered for the effective working of the act, but nothing has come of it. In olden time the remedies for such misdemeanours were quick and effectual. In the *Assisa panis*, for example, as set forth in *Liber Albus*, there are not only the strictest regulations concerning the manner in which the business of the baker is to be conducted, but there are also the penalties for failing in the same. "If any default," it says, "shall be found in the bread of a baker in the City, the first time let him be drawn upon a hurdle from the Guildhall to his own house through the great streets where there be most people assembled, and through the great streets which are most dirty, with the faulty loaf hanging from his neck; if a second time he shall be found committing the same offence, let him be drawn from the Guildhall through the great street of Cheepe, in manner aforesaid, to the pillory, and let him be put upon the pillory, and remain there at least one hour in the day; and the third time that such default shall be found, he shall be drawn, and the oven shall be pulled down, and the baker made to forswear the trade within the City for ever." It further tells us that William de Stratford suffered this punishment for selling bread of short weight, and John de Strode for making bread of filth and cobwebs. One hoary-headed offender was excused the hurdle on account of his age and the severity of the season; and it would seem that the last time the punishment was inflicted was in the sixteenth year of the reign of Henry VI., when Simon Frensshe was so drawn. A like punishment was awarded to butchers and vintners for fraudulent dealings; for we are told that a butcher was paraded through the streets with his face to the horse's tail, for selling measly bacon at market, and that the next day he was set in the pillory with two great pieces of his measly bacon over his head, and a writing which set forth his crimes. In the judgments recorded in *Liber Albus* there are twenty-three cases in which the pillory or the thew was awarded for selling putrid meat, fish, or poultry; thirteen for unlawful dealings of bakers, and six for the misdemeanours of vintners and wine-drawers. Of a verity we have degenerated in these matters.

And now, in conclusion, having directed your attention to the nutritive values of different kinds of food; to their functional and dietetical powers; to the modes in which they are associated; to the quantities required for ordinary labour; to the manner in which they are digested; to the effects of culinary and other treatment; to the way in which they may be preserved; and to the causes of their unwholesomeness, we may finally ask if any great generalisations can be deduced from our inquiries?

In the first place, you will, I think, have observed that there are very striking evidences of design in the way in which organic matter is constantly kept in motion, for, whether living or dead, it is always in a state of molecular activity—either advancing towards the highest state of organisation, or retreating to the confines of the mineral kingdom. The result of this is that, with a comparatively small amount of material, and with but little expenditure of force, the work of the living world is fully and effectively performed. Starting from the mineral kingdom, as carbonic acid, water, and ammonia, the elements of organic nature pass through a succession of changes, first in the vegetable and next in the animal, until they reach the summit of organisation, when they again return to their primitive condition. In this manner a never-ending round of change is perpetuated, and the same material and the same force are kept moving in the same continuous circle. Through the efforts of the plant the crude materials are formed into vegetable acids, sugar, gum, starch, fat, albumen, and tissue; and then the animal converts them into higher forms of structure, as gelatine, muscle, and brain; the two extremes, therefore, of these changes are, to use the words of Gerhardt, carbonic acid, water, and ammonia at one end; albumen, gelatine, fat, and cerebral matter at the other—but the transitions to these extremes are countless, and are as yet beyond the reach of science. Broadly, however, we may say that the chemical functions of the plant are those of reduction or deoxidation, whereby carbonic acid and water are deprived of their oxygen and moulded with nitrogen into food; while those of animals are of an opposite nature, for they destroy this food by oxidation. The plant, therefore, is the machine or medium whereby carbonic acid, water, and ammonia are converted into new compounds, and light and heat are transformed into chemical affinity; and the animal is the medium or machine whereby these compounds are destroyed, and their affinities changed into other manifestations of force, and finally into heat. In this way, the circuit of change is completed; and it is not difficult to trace the phenomena of vitality to the cosmical forces which the plant had imprisoned. But shall we ever be able to follow, through all the intricacies of change, the countless transitions of both matter and force in their passage from the mineral kingdom to the animal, and then back to the mineral again? It is easy to connect, by a correlation of force, the muscular movements of the animal body, and even the highest efforts of the human mind, with the sunbeam which the plant had arrested; but shall we ever be permitted to unravel those mysterious functions, those intermediate changes which constitute the phenomena of life? Why is it, for example, and how comes it, that the living

cell of the plant is able to aggregate mineral matter in opposition to the common laws of affinity, and can transform light and heat into cell-force? How is it, too, that the animal, in reversing the process, and so restoring the play of affinity, is able to transmute it into other manifestations of force? At present, the utmost we can say of it is, that organic matter is the appointed medium of all these changes, and is designed for the exhibition of vital phenomena, just as mineral matter is the appointed medium for the phenomena of electricity and magnetism; and yet to some extent, perhaps, we are able to penetrate the mystery; for, by finding the clue to the peculiar action of the vegetable in reducing chemical compounds, we can, by operating on such substances as carbonic acid, water, and ammonia produce a large number of organic principles; in fact, of the three great classes of alimentary substances, to which I have so frequently directed your attention—namely, the oleaginous, the saccharine, and the albuminous—it may be said that the first is already within the manufacturing power of the chemist, and the second is nearly within it; so that there is abundant proof that the agency of a vital force is not necessary to the formation of organic compounds; and there is even hope that the fabrication of food may not be altogether beyond the capabilities of man.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 18th, 1869.

Dr. WARREN DE LA RUE, F.R.S., President, in the Chair.

PREVIOUS to the reading of papers, the President announced from the chair that it had been proposed to substitute the name of Dr. J. L. W. Thudicum for that of Mr. E. T. Chapman in the balloting papers for the Council. The proposal would be suspended in the Society's rooms, along with the printed list, according to the by-law.

Dr. GUTHRIE wished to know if he could make a resolution before the papers were read; but it was decided that it had better be left till the aniversary meeting.

A paper by Mr. ARTHUR ELLIOTT, "*On the Determination of Carbon in Cast-Iron*," was read by Mr. Vacher, who remarked that the great advantage of the process was that it had succeeded well in not very experienced hands, where other processes had failed. The author's method is adapted principally from Ullgren (*Anal. d. Chem. u. Pharm.*, 124, 59), and consists in treating from 2 to 2·5 grammes of pulverised iron borings, rejecting any large pieces, with 50 c.c. of solution of sulphate of copper (1 in 5), heating gently for ten minutes, when the iron dissolves and metallic copper separates, the carbon remaining undissolved. 20 c.c. of solution of chloride of copper (1 in 2) and 50 c.c. of HCl are then added, and the mixture heated nearly to the boiling point, until the separated copper dissolves. The carbon is collected on a filter made of combustion tube, 15 c.m. long, one end being drawn out to a point 4 m.m. wide, and stopped first with broken glass, and then loosely with ignited asbestos, and washed with boiling water till free from chlorides. It is then converted into carbonic acid, and the latter determined, by transferring the carbon in the tube to a flask, adding 3 grammes of chromic acid, the flask is then supplied with a funnel tube and attached to a bottle one-third full of sulphuric acid, and this is connected with a U-tube, filled with pumice-stone saturated with sulphuric acid. This tube is connected with two smaller U-tubes, for absorbing the carbonic gas—one containing soda-lime, and the other pumice and sulphuric acid. 30 c.c. of sulphuric acid are gradually added to the flask, which is shaken, and the contents boiled for one minute; the tap of the funnel tube is opened, and a tube containing soda-lime connected; an aspirator is then applied to the small U-tube containing pumice and sulphuric acid, and air drawn at the rate of two or three bubbles per second.

The PRESIDENT thought that in rejecting any part of a given sample which would not pulverise, there was a danger of rejecting a portion of iron having a different proportion of the metal to the carbon, as compared with the rest of the sample. Mr. Forbes, who had given attention to the subject, would perhaps favour them with some remarks.

Mr. FORBES did not like to offer any opinion on the process till he had tested it himself. He had tried every process that had been made known, and was not at all satisfied of their great accuracy. He, and many others, would be very glad to submit the present process to enquiry, to determine its accuracy.

The next paper was a rather long one, by Mr. E. T. CHAPMAN and Mr. MILES H. SMITH, which was followed by a discussion. Owing to pressure of matter, we are compelled to postpone our report of it till next week.

Dr. ODLING then read a paper, by Professor G. G. Stokes, F.R.S., "*On a Certain Reaction of Quinine.*" The author stated that some time had elapsed since he had made these investigations, but not being a chemist, he had not ventured to lay the results before the chemical world; he had recently, however, been encouraged by a chemical friend to think that a fuller statement might prove of some interest to chemists. The reaction is best observed by diffused daylight entering a darkened room through a hole in the shutter of about 4 or 5 inches square, or a packing case may be made to answer very well. The hole is covered with glass coloured a deep violet by manganese. In front of it is placed a white porcelain tablet; a solution of quinine in very weak alcohol, or very small fragments may be used. In some cases, alcohol interferes with the reaction. The phenomena exhibited by sulphuric and hydrochloric acids were as follows:—When a drop of the quinine solution was touched by a rod dipped in dilute sulphuric acid, the fluorescence of the quinine was instantly developed. With hydrochloric acid, no apparent effect was produced, but hydrochloric acid destroyed the effect of sulphuric acid; and if a little sulphuric acid were added to the drop containing only hydrochloric acid, no effect was manifest. The author found that, on trying a variety of acids, they ranged definitely into two classes, A and B—class A developing fluorescence like sulphuric acid, and class B destroying it, like hydrochloric acid. The alkaline salts of the acids were found to destroy the fluorescence, as well as the free acids themselves. The following are the acids operated on by the author:—*Class* A. Acetic, arsenic, benzoic, chloric, citric, formic, hyposulphuric, iodic, malic, nitric, oxalic, perchloric, phosphoric, silico-fluoric, succinic, sulphuric, tartaric, and valerianic. *Class* B comprises hydriodic, hydro-bromic, hydrochloric, hydroferrocyanic, hydropalladiocyanic, hydroplatinocyanic, hydrosulphocyanic, and hyposulphurous. The character of the fluorescence of the salts of quinine in the solid state varies; the solid iodate obtained by precipitation is strongly fluorescent, with a blue considerably deeper than that of the solutions. The absorption of the fluorogenic rays by the yellow ferrocyanide of potassium would, in itself, account for the apparent destruction of the fluorescence, if the salt were present in sufficient quantity; but, to destroy the fluorescence, a less quantity is sufficient than would be required to prevent its exhibition by the absorption either of the fluorogenic or of the fluorescent rays, or of both; the author therefore concludes that the removal of the fluorescence is a true chemical reaction, and not a mere optical effect. The classification made by the quinine reaction agrees almost exactly with the old distinction of ox-acids and hydracids. The author had found, however,

that hyposulphurous acid, which is not usually ranked with the hydracids, ranged itself in class B, and led him to seek for other analogies between hyposulphurous and the hydracids; and he found that hyposulphite of soda restored the blue colour to litmus which had been reddened with chloride of mercury; he also found that, in common with the hydracids, it very readily decomposed cyanide of mercury. Fluorescence had been restored without precipitation, in the case of hydrochloric acid, by the sulphate or nitrate of the red oxide of mercury, and that the restoration of fluorescence was not a mere effect of the acid with the mercuric salt could be proved by adding just enough hydrochloric acid to destroy fluorescence in quinine dissolved in nitric or sulphuric acids; on stirring a little precipitated oxide of mercury in the mixture, the fluorescence returned. The fluorescence, destroyed by a chloride, was in some measure restored by nitrate of cadmium. The precipitate obtained with bromide of potassium was white, and showed a pretty orange fluorescence—a very unusual colour for the fluorescence of a white substance.

The PRESIDENT spoke of the importance of Professor Stokes's interesting paper; it was very possible that considerable light would be thrown on the nature of different chemical compounds by such facts as he had brought forward. Although spectroscopic analysis was more general in its application to rays of all refrangibilities, it would be of some value in dealing with the fluorescent rays, which are rays of one, or very few different, refrangibilities.

Dr. ODLING said that if he had not occupied too much time, he would like to make a remark on the composition of hyposulphurous acid, as to whether it was a hydracid or an ox-acid. Hyposulphite of soda was generally written by the formula $Na_2S_2O_3$, together with an atom of water, and the atom of water was essential to all the hyposulphites. If, instead of writing the formula in this manner, it was written $Na_2H_2S_2O_4$, it might represent the single or the double molecule of hyposulphite of soda. Assuming it represented the double, the formula for the simple hyposulphite would be $NaHSO_2$, and that salt would correspond to an acid H_2SO_2, of which the next term would be H_2SO_3, and the next H_2SO_4. If this was the correct formula for hyposulphurous acid, it might evidently be regarded as a hydracid. Dr. Dupré had read a paper which contained this suggestion. He (Dr. Odling) thought that when Dr. Dupré brought forward this formula, he viewed it as the analogue of formic acid, and as, in that acid, one of the atoms was replaced to form formate of soda, so, in hyposulphurous acid, only one atom was replaced to form hyposulphite of soda; but if this were correct, it did not follow that this acid was the analogue of formic acid as regards its internal molecular arrangement. There was no doubt of formic acid being an ox-acid; but hyposulphurous, even with this formula, might be a hydracid. HCl represented hydrochloric acid, and HOCl, hypochlorous acid, so that the hydrogen was united to the chlorine by the oxygen, and it is a true ox-acid. The fact that NO_2 was capable, in a great number of cases, of taking the place of Cl made it an open question whether it was not a hydracid, notwithstanding its containing oxygen, on the assumption that hydrogen was not directly united with oxygen, as in the case of hypochlorous and cyanic acids. Nitric acid, HO,NO_2, in which (assuming, from the nature of the body) the hydrogen is directly associated with the oxygen, is a true ox-acid, and starting from this point, we have hyposulphurous acid, which would be a true hydracid; sulphurous acid, which would be an intermediate acid; and sulphuric acid, which would be an ox-acid. The hyposulphites certainly corresponded with the halogen salts in their remarkable tendency to form double salts, the *raison d'etre* of which was not satisfactorily established. The constitution of the double chlorides of mercury and sodium, and of mercury and ammonium, had not been accounted for on the ordinarily-received views of atomicity, unless Mr. Wanklyn's view was followed, and a higher atomicity given to them than was generally accorded. He (Dr. Odling) objected to elaborated formulæ, for those chemists who wrote the formula of hyposulphurous with the two sulphurs written in different ways, and the oxygen in different ways, assumed that they knew all about it; but he thought there was a great deal to be learned, and the best way was to express it ordinarily, in the most compressed form, and then, as an illustration, put forward some further elaborated scheme, which might, and very likely might not, be true.

The PRESIDENT announced that the next meeting of the Society would be the Anniversary Meeting, on March 30th, at 8 o'clock; and he asked as many gentlemen as possible to attend, as the officers would be elected and he would have to resign the Presidentship.

CORRESPONDENCE.

THE CHEMISTRY OF SUGAR REFINING: BEANES'S PROCESS FOR PURIFYING BONE-BLACK.

To the Editor of the Chemical News.

SIR,—Will you kindly afford me space to explain the cause of the apparent inconsistency between the views expressed by Dr. Wallace on the above subject and those which Mr. P. Casamajor has embodied in the letter which you published last week?

The fact announced by Dr. Wallace, that "acids invert cane sugar," has been known to me for the last thirty years, and is, I believe, familiar to most persons engaged in the sugar manufacture. So well, indeed, is it understood in America and on the continent of Europe, that every precaution is taken to neutralise the acidity of the crude sugar before submitting it to the action of the animal charcoal. This practice does not prevail in England; sugar refiners here trust to the calcic carbonate present as an impurity in the charcoal for the neutralisation of the acid of the sugar; and, as my process removes this calcic carbonate, it renders the charcoal less suitable for the rude and unscientific method in vogue here, than it is for the greatly superior method adopted in countries where the manufacture is better understood.

The decolourising effect of bone-black upon syrup is in proportion to the extent of *carbon surface* exposed. The smaller the grains the greater is the decolourising effect produced; and yet our sugar refiners load with calcic carbonate—*white-wash*, as it were,—the very carbon surface upon which they depend for the decolourisation of their syrups! The practice seems to me, I confess, irrational in the highest degree.

Old bone-black, freed from lime and other impurities, is inferior in power to new because its carbon surface is less. Its innumerable little prominences have been removed by friction, it has become polished, and the extent of surface which it exposes is thereby reduced, but it is nevertheless, as might have been expected, very much more efficient than a similar black from which the calcic carbonate has not been removed.—I am, &c.,

E. BEANES.

Cordwalles, Maidenhead, Berks,
March 15th, 1869.

THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—As the writer of the letter which was read from the chair at the last meeting of the Chemical Society, proposing that the name of Mr. Ernest Theophron Chapman should be replaced by that of Dr. J. L. W. Thudicum as one of the new members of Council, I shall be glad if

you will kindly afford me the opportunity of giving the reasons which induced me to take so decided a step.

Of Dr. Thudicum, I may remark that he is a gentleman holding a high official position; his advice and assistance on scientific and chemical subjects are frequently sought by different departments of Government; and his researches in spectrum analysis, and elaborate investigations on chemical pathology in connection with the cholera are of very high scientific value, besides being of almost national importance. Besides this, the gentleman I have the honour to nominate has the advantage of five years seniority in our society over Mr. Chapman. Of the latter gentleman, I do not wish to say anything that can detract from his known ability, but think that the interests of the Society would not suffer from his absence from the governing body—at least until his judgment is a little more matured.—I am, &c.,

JOHN SPILLER.

[We feel it our duty to allow Mr. Spiller the opportunity of stating the reasons which induced him to write the letter which was read from the chair at the last meeting of the society. According to the fifth by-law, our correspondent's proposal, after having been read from the chair, is to be publicly suspended in the society's rooms with the list recommended by the council. The balloting papers, which have now been sent to all members of the society, contain a notice which is intended to meet such a case as this. They state "If you wish to substitute any other name in place of that proposed, erase the printed name in the second column and write opposite to it in the third that which you wish to substitute.—*Ed. C. N.*]

MISCELLANEOUS.

The Presidency of the Chemical Society.—Dr. Frankland having been nominated by the Council to the Presidency of the Society for the ensuing year, and he having felt himself obliged to decline the office,—at a subsequent meeting of Council Dr. Williamson was nominated instead, and new balloting lists were ordered to be circulated among the Fellows.

Discovery of Platinum in Scotland.—According to a brief account in the *Mining Journal*, an explorer announces that, during his investigation into the auriferous nature of Scotch quartz, he has discovered small quantities of platinum associated with the gold there existing. The platinum exists in the form of small scales resembling silver, but they are not magnetic like much of the crude platinum found in South America. In the process employed the gold was volatilised by chlorine at a bright red heat, but the platinum was left unacted on by the chlorine. Platinum is very rarely found in this country. Some ten years ago Mr. W. Mallet, of Dublin, found crude platinum in minute grains and scales associated with gold, wood tin, &c., in the auriferous sands of some of the Wicklow rivers; about the same time it was also said to have been met with on a farm near the mouth of the river Urr, in Buittle, Kirkcudbright. Platinum has also been found near Loch Camhead.

Explosion at Paris.—On Tuesday afternoon, the 16th inst., at about 3.40 p.m., a most serious accident occurred at No. 2, Place de la Sorbonne, Paris, on the left bank of the Seine, in which premises the cellars and ground floor are occupied by M. Véron Fontaine, manufacturing chemist, as a store and retail shop. During the morning of the above day, there had been delivered at that place a parcel containing 28 kilogrammes of picrate of potash, intended to be forwarded to the experimental submarine torpedo manufacturing establishment, situated on the Isle d'Aix, on the coast of the Département de la Charente Inférieure, there to be employed in experiments. It is not precisely known what caused this material to explode, but it is surmised to be due to carelessness. The violence of the explosion was increased by the fact that a portion of the large quantity of ether and alcohol stored in glass carboys in the cellars of the premises, on their vapour becoming mixed with air, in consequence of the breaking of the carboys by the shock of the explosion, partly exploded, and, becoming inflamed, set the whole building in a blaze. It is authoritatively denied that any picrate of potash was made on the premises; and that neither nitroglycerine nor any fulminates, nor gun-cotton, nor gunpowder were ever in the place at all. The manufactory is situated in the remote outskirts of Paris, in a lonely and secluded spot.

Aniline Grey.—The following recipe has been published by M. Bloch, to produce an aniline grey colour:—1 kilo. of aniline at 190°, and 5 kilos. of arsenic acid in a liquid form at 75°, are taken and heated on the open fire in a cauldron, care being taken to maintain the heat at the boiling point, till the substance thickens and rises, when the operation is terminated and the vessel is removed. The substance obtained presents a blackish appearance; it is thick, and insoluble in water. In order to purify the product, about 20 litres of water, and 1 kilo. of muriatic acid are taken and boiled with steam for half an hour; after which the mass is filtered. The matter which is deposited on the filter is collected, washed with boiling water, and operated upon a third time by a small quantity of carbonate of soda in solution, so as completely to neutralise the acid. Finally, the collected matter is dried, and gives a fine black powder. The solution of this product is made by treating it with alcohol, with an addition of 10 per cent of sulphuric acid. Nothing now remains to be done but to filter it. With this liquor, magnificent greys of all shades are dyed, by submitting its mordant to the dyeing bath. For the dyeing and printing of this grey colour, the matter must first be passed through a water bath, strongly acidulated with sulphuric acid. A skein of silk or wool is dyed by five drops of this liquor.—*Moniteur Scientifique.*

NOTES ON LECTURE EXPERIMENTS.

Sudden Crystallisation.—I should be glad to know the best method of preparing a solution of Glauber's salts for showing sudden crystallisation. My principal difficulty is in avoiding the breakage of the glass flask in which the solution is prepared. I am speaking now of a quantity suitable for a lecture experiment—say a solution containing 10 or 15 lbs. of the salt.—CRYSTAL.

To Burn Oxygen or Air in Hydrogen or Coal Gas, to Show that Combustible and Supporter of Combustion are Relative Terms.—The following simple arrangement does very well indeed for experiments of this character:—A piece of glass tube, a foot or so in length and about an inch in diameter, is fitted with a good cork at each end. Into one of the corks is inserted a short piece of glass tubing, ¼ inch in diameter, to which is attached a piece of caoutchouc tubing provided with a pinch-cock. The other cork is perforated, and a metal tube, 2 or 3 inches long and ¼ an inch or so in diameter, is inserted into the cork, but does not pass through it. The tube is filled with hydrogen or coal gas. For this purpose it is clamped upright, metal tube downward, and the gas is let in at the top through the caoutchouc tube; when full, a light is applied to the gas at the extremity of the metal tube, and the pinch-cock turned, until the supply of gas is reduced so that there is a small flame only from the metal tube. A glass tube, about ¼ inch diameter and terminating in a moderately fine jet, is now connected with a bag, or gas holder, containing oxygen, the oxygen turned on, and the glass jet, with the issuing oxygen, passed through the metal tube into the glass one, when the oxygen, lighted as it enters, will burn in the glass tube containing the coal gas or hydrogen. To burn air, a similar small tube is taken, but with a large jet; the tube is connected by caoutchouc pipingwith a common pair of bellows, and then, while an assistant gently blows air from the bellows through the glass tube, it is passed through the metal pipe, when the air will burn in the same manner as the oxygen, but with a feebler flame. To burn the breath, an experiment, I believe, shown for the first time by Dr. Odling, the same small tube may be used as the one just now mentioned, air being gently blown

from the mouth while the tube is introduced into the hydrogen. The following are the conditions, or essentials of success, in the above experiments:—(*a*) The glass tube must be completely filled with gas before lighting, that no explosion may occur. (*b*) The delivery (glass) tube, connected with the bellows or the mouth, must be sufficiently large, and the air must be driven through the tube gently. (*c*) In passing the ignited air into the glass tube, the jet should not touch the metal pipe, as it may be extinguished on its passage. A paraffin lamp chimney will serve very well instead of the straight glass tube spoken of, and is, perhaps, more easily obtained. There is one circumstance which mars this experiment to some extent, and that is the deposition of moisture on the interior of the tube, which soon accumulates to such an extent as to prevent the audience from seeing clearly the burning air within. I should be glad of any hint for a method of preventing this deposition of moisture.—C. J. WOODWARD, Midland Institute.

CONTEMPORARY SCIENTIFIC PRESS.

(Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the "Chemical News." A more complete list containing the omitted papers and contents of journals devoted to other branches of science, is published at the Patent Office, in the library of which the periodicals themselves may be consulted'.

Comptes Rendus.

December 7, 1868.

SECCHI, "On some Peculiarities of the Spectra of Solar Protuberances." A. DAMOUR, "Analysis of Adamine from Cape Garonne, Var." A. RICHE, "Researches on the Alloys of Copper and Tin." BERTHELOT, "On the Combination of Free Nitrogen with Acetylene, and on the Direct Synthesis of Hydrocyanic Acid." H. MONTUCCI, "Note on the Lunar Protuberances observed by De Créty at Aden during the Eclipse of the Sun of August 18, 1868.'

December 14, 1868.

MOUCHOT, "On the Application of Solar Heat as a Substitute for Fuel in certain Countries." WARREN DE LA RUE, "Observations on Pincus's Claim to the Invention of a Constant Voltaic Battery described by the Author and H. Müller." BERTHELOT, "On the Formation of Acetylene, and on some other Phenomena of the Action of the Electric Spark on Marsh Gas." C. FRIEDEL, "On a new Mode of Formation of Acetenylbenzine, and on the Homologues of Acetylene." L. TROOST and P. HAUTEFEUILLE, "On Some Properties of Cyanic Acid." FILHOL and MELLIER, "On the Action of Iodine on Certain Sulphides."

Sitzungsberichte der Königlich Bayerischen Akademie der Wissenschaften zu München. (Mathematischphysikallische Classe.)

November 9, 1868.

BUCHNER, "On the Formation of Sulphide of Arsenic in the Corpse of a Person Poisoned by Arsenious Acid." C. VOIT, "On the Formation of Fat in the Animal Body."

December 7th, 1868.

F. VON KOBELL, "On Typical and Empirical Formulæ in Mineralogy." BUCHNER, "On the Composition of the Blood in Cases of Poisoning by Prussic Acid."

Annalen der Chemie und Pharmacie.

November, 1868.

C. BENDER, "On the Behaviour of Oxysulphide of Carbon towards an Alcoholic Solution of Potash." J. DUVERNOY, "On Pimaric Acid and its Derivatives." E. G. STRAUSS, "On the Composition of Copaiba Balsam." "On Toluylene-Urea." O. VEIBL, "On the Transformation of Fatty Acids into the Alcohols of the Parallel Series." F. LOSSEN, "On the Oxidation of Acetic Acid to Oxalic Acid." W. HEINTZ, "On Glycocolamide and Diglycolamadic Diamide." J. WISLICENUS, "On the Brominated Addition Product of Pyroracemic Acid." J. DEMBEY, "On the Transformation of Chlorobenzoic Acid into Oxybenzoic Acid." N. VON DER BRUGGEN, "On the Diethyl Ether of a Dilactic Acid." KRAUT, "On Atropine." "On Cinnamic Acid and its Isomer Atropic Acid." E. LINNEMANN, "On the Reduction of Acetic Anhydride to Ethylic Alcohol." "On the Synthesis of Normal Primary Propylic Alcohol of Fermentation." A. SIERSCH, "Researches on the Transformation of Isopropylic Alcohol into Butylic Alcohol." "On Isopropylamine and Diisopropylamine."

Journal fur Praktische Chemie.

November, 1868.

A. H. VAN ANKUM, "On the Essential Oil and the Poisonous Principle of the Root of the *Cicuta virosa*." W. L. CLASEN, "On the Influence of Potash Manure on Beetroot."

December, 1868.

A. RUMPLER, "A Volumetric Method of Estimating Copper." F. VON KOBELL, "On the Crystalline Spessartin of Aschaffenburg, and on a Dense Variety from Pfitsch." "On a Specimen of Almandine from Northern Columbia." C. F. SCHONBEIN, "On the Occurrence of Active Oxygen in Organic Substances." "On the Transformation of Nitrates into Nitrites by Conferva and other Organic Tissues." "On some Chemical Properties of the Seeds of Plants." "On the Most Delicate Test for Peroxide of Hydrogen." "On the Behaviour of Extract of Malt and Blood Corpuscles towards the Free Oxygen contained in Camphine and in Fatty Oils." "On the Behaviour of Aldehyde towards Ordinary Oxygen." "On the Behaviour of certain Organic Matters towards Ozone."

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

510. E. Dorsett, London Street, London, "Improvements in means and apparatus for heating, smelting, and working metals, and in furnaces employed therein, which improvements are also applicable to heating, and otherwise operating upon minerals and other substances."—Petition recorded February 19, 1869.

533. T. H. Simmonds, Great Mitchell Street, in the county of Middlesex, and E. B. Moreland, Bartholomew Close, London, "An improved compound for glazing or "finishing" linen-faced paper used in the manufacture of collars and cuffs, and for other purposes."—February 20, 1869.

546. T. S. Blair, Pittsburg, Penn., U.S.A., "Improvements in the manufacture of iron and steel."

548. B. J. B. Mills, Southampton Buildings, Middlesex, "Improvements in the manufacture of artificial stone."—A communication from W. Munroe, Boston, Mass., U.S.A.—February 22, 1869.

565. S. Holroyd, Newton Heath, Manchester, "Improvements in the recovery of substances used in the purification of gas for illumination, and of waste products arising therefrom."

566. H. Bessemer, Queen Street Place, Cannon Street, London, "Improvements in the construction and arrangement of machinery, apparatus, and buildings employed in or for the manufacture or production of cast-steel and malleable iron from pig or other carburet of iron."—February 23, 1869.

574. J. J. Vaughan, Mitre Lane, near Kensal Green, Middlesex, "Improvements in treating, converting, and utilising the metallic salts and sulphuric acid contained in or derived from the residual or waste liquors of tinned plate works and petroleum and paraffin refineries."—February 24, 1869.

586. W. E. Newton, Chancery Lane, "Improvements in furnaces and apparatus for oxidising and desulphurising iron and other ores."—A communication from W. H. Reinoehl, Pine Grove, Penn., U.S.A.—February 25, 1869.

597. J. A. F. Suter, Hereford, and. T C. Hinde, Fownhope, near Hereford, "Improvements in furnaces and in the combustion of fuel for melting steel, and for other purposes where high temperatures are required."

598. G. J. Hinde, Wolverhampton, "Improvements in coating iron or steel with copper or brass, or other alloys of copper."

600. J. Townsend, Glasgow, N.B., "Improvements in extracting and in refining oils and other products from mineral and other materials containing carbon and hydrogen, and in apparatus therefor."—February 26, 1869.

621. J. Rust, Lambeth, Surrey, "A new or improved composition specially applicable for use for pictorial and decorative purposes."

632. J. G. Willans, St. Stephen's Crescent, Paddington, "Improvements in the manufacture of iron and steel, and in apparatus employed therein."—March 1, 1869.

637. J. Townsend and P. Forbes, Glasgow, N.B., "Improvements in refining or purifying oils and fats."—March 2, 1869.

641. F. A. Gatty, Accrington, Lancashire, "A certain process or processes for obtaining the colouring matter of madder and another useful product."—March 3, 1869.

INVENTIONS PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF COMPLETE SPECIFICATIONS.

670. W. E. Gedge, Wellington Street, Strand, Middlesex, "An improved process and improved apparatus, having for object to preserve from oxidation iron ships and metallic surfaces, or those of copper or iron with which wooden ships are sheathed; also applicable for testing the qualities and the homogeneity of metals."—A communication from E. Demance and G. J. Berlin, Faubourg St. Martin, Paris.—Petition recorded March 5, 1869.

713. H. A. Bonneville, Chaussée d'Antin, Paris, "A new sort of porcelain, and a new and improved process for manufacturing the same."—A communication from A. Vidal, Rue St. Sauveur, Paris.

NOTICES TO PROCEED.

3226. C. Macmillan, Sunderland, "Improvements in protecting iron ships and other submerged surfaces from corrosion and marine growths, and in compositions to be so employed."—Petition recorded October 21, 1868.

3256. A. Giraud, Gray's Inn Road, Middlesex, "Improvements in separating silver from argentiferous lead, in purifying lead, and in apparatus for the same."—October 24, 1868.

3267. P. M. Crane, Manchester, "An improved compound or size to be used in sizing and dressing cotton yarns or cotton warps."—October 26, 1868.

3309. W. H. Liddell, Edinburgh, "Improvements in treating all kinds of pig skins in the processes of preparation, tanning, currying, enamelling, and japanning, and in utilising the products."

3315. R. Oxland, Plymouth, "Improvements in the treatment of ores and minerals for the extraction of tin."—October 29, 1868.

3352. M. Sautter, Rue de la Chaussée d'Antin, Paris, "Improvements in preparing and preserving vegetable and animal substances."—A communication from W. O. Giles, New York, U.S.A.—November 4, 1868.

3761. W. S. Jackson, Walworth, Surrey, "An improved method of treating bones and the products obtained therefrom, so as to render them available for various useful products."—December 10, 1868.

370. W. R. Lake, Southampton Buildings, Chancery Lane, "Improvements in puddling and other furnaces employed in the manufacture of wrought-iron and steel."—A communication from S. Danks, Cincinnati, Ohio, U.S.A.—February 6, 1869.

386. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved lining for puddling and other furnaces."—A communication from S. Danks, Cincinnati, Ohio, U.S.A.—February 8, 1869.

NOTES AND QUERIES.

Preservation of Meat.—According to Marchal de Calvi, meat may be kept in a fresh state and without risk of putrefaction by being placed for some fifteen or twenty minutes under a bell jar wherein sulphur has been suffered to burn.

Action of Heat on Zircons.—Henneberg (*Chemical Gazette*, 1847, vol. v., p. 96) noticed that zircons increased in density by being heated, the change being accompanied by phosphorescence and a permanent lightening of colour. Previous to ignition the crystals possessed the specific gravity 4·615, and after ignition 4·710.

Separation of Zinc and Copper.—M. G. C. Wittstein writes, in his *Revue Trimestr.*, that for the separation of zinc from copper the treatment of the sulphides with dilute sulphuric acid may be applied, being the method pointed out by Dr. Hofmann for separating cadmium from copper.

Aniline Green.—It is stated that Dr. Hofmann and Mr. Charles Girard at Berlin have successfully obtained pure aniline green, which green is only distinguished from the aniline violet by the elements of iodide of methyl, so that the violet can be readily converted into the green and the green into the violet.—*Moniteur Scientifique.*

Gardenia Grandiflora.—Can any of your correspondents inform me through the medium of Notes and Queries where a small quantity of the seed of *Gardenia grandiflora* could be procured for experimental purposes? What would be the best means of bringing into notice a method for improving low, greenish qualities of indigo?—CHROMO.

Oil from the Curcas Purgans has been investigated by Da Silva, who states that it furnished him a small quantity of octylic alcohol, and that it yields as much as 6·10 per cent of nitrogen. The *Curcas purgans* is an Euphorbiaceous plant, which furnishes a kind of castor oil; it grows in many parts of Africa, and especially in the Cape de Verd Islands.

Desulphurising Coal.—Messrs. Grandidier and Marcel have invented an apparatus for decomposing, by means of the combined agency of heat and compressed air, or heat and high pressure steam, the sulphurets of of iron contained in ores, coal, and also coke. The sulphur oxidised completely, without affecting the good qualities of coal or other material submitted to the action of this process.

Influence of Pressure on Chemical Action.—According to experiments and observations made by Cailletet, the strongest acids, properly mixed with water, cease to exercise any solvent action or to disengage hydrogen gas from iron, tin, zinc, aluminium, sulphide of iron (sulphuretted hydrogen gas), when a strong pressure is made to exercise its influence within the vessel wherein the chemical action is taking place.

New Freezing Mixture.—I have made an observation which appears to me of considerable interest. When citric acid and crystallised carbonate of soda, in powder, are stirred together, the mass gets into a pasty state, and in a short time becomes quite liquid. If equivalents of the substances are used, the temperature falls from 60° F. to 8° F. The mixture, for a time, is full of air bubbles, but soon becomes a clear, dense, syrupy fluid. The few cases in which dry solids act on each other at ordinary temperatures give a value to each additional instance.—JOHN GALLETLY.

Cement to Resist Red Heat and Boiling Water.—To four or five parts of clay, thoroughly dried and pulverised, add two parts of fine iron filings free from oxide, one part of peroxide of manganese, one-half of common salt, and one-half of borax; mingle thoroughly; render as fine as possible; then reduce to a thick paste with the necessary quantity of water, mixing thoroughly well. It must be used immediately. After application it should be exposed to warmth, gradually increasing almost to a white heat. This cement is very hard, and presents complete resistance alike to a red heat and boiling water.

Another Cement.—To equal parts of sifted peroxide of manganese and well pulverised zinc white add a sufficient quantity of commercial soluble glass to form a thin paste. This mixture, when used immediately, forms a cement quite equal in hardness and resistance to that obtained by the first method.—*Blätter fur Gewerbe.*

Chemical Nomenclature.—It strikes me that "H. H." has not clearly expressed what he means. The well-known character of organic radicals has been so abundantly established, and so many have been isolated in subsequent corroboration of their nomenclature, that perhaps it would be unwise to complicate a structure already far too cumbrous; but there are oxy-, chloro-, &c., carbydrogen combinations which I would suggest have been greatly confused and misunderstood by modern chemists in treating them as oxides, chlorides, &c. That we have an oxide or binoxide of (C_2H_4) or (C_4H_4) in the sense that we have oxides of ethyle or methyle, or that these so-called diatomic radicals can replace either H or 2H is what I would most strongly call in question.—S. E. P.

Essence of Patchouli, either when left to itself or when treated with dehydrating substances, yields a camphor which is a black-coloured solid substance, and has a composition which is isomeric with the essence; its composition is represented by $C_{20}H_{26}$, it melts at between 54° and 55° C., and boils at 296°; density = 1·051 at 4·5° C. Vapour density at 324° = 8·00. When essence of Patchouli is heated up to from 282° to 294°, it is entirely converted into this camphor, which is, moreover, homologous with Borneo camphor.

Paraffin.—Dr. Bolley has found that paraffin (a pure sample of which having its melting point at 53° C., and which on analysis was found to contain in 100 parts—C, 85·61; H, 14·69), after having been kept for eight days at a temperature of 150° C., had become a brownish pasty mass. A portion thereof was soluble in alcohol, and was unaltered paraffin, but the dark coloured residue yielded on analysis C, 70·04; H, 10·25; O, 19·72. A sample of paraffin which had been kept for some time at 300°, gave off vapours on being afterwards again heated up to 150°. Paraffin is, in all probability, a mixture of various hydrocarbons, all of which have varying melting and boiling points.

Welding Copper.—The great obstacle hitherto experienced in welding copper has been that the oxide formed is not fusible. Mr. P. Rust, starting from the well-known fact, that libethenite and pseudo-malachite (both native compounds of copper and phosphoric acid) are very readily fusible before the blowpipe, concluded that any salt containing free phosphoric acid or capable of yielding it at red heat would make the weld easy by removing the oxide as a fusible slag. A first trial was made with microcosmic salt (phosphate of soda and ammonia) and succeeded perfectly; as that salt, however, is rather expensive, he substituted for it a mixture of one part of phosphate of soda and two parts of borax, which answers the purpose, although the slag formed is not so fusible.—*Abbreviated from Dingl. Journ.*

Positive or Negative?—A subscriber to the CHEMICAL NEWS deeply sympathises with "A Medical Student." There is no doubt that our manuals on chemistry and electricity are very confused, but they are all right from different points of view—except all the nonsense about negative H, hydracids, &c., which is intensely absurd. He should try and master the essential philosophy of battery action, and be independent of such pitiful guides. Each end of the battery action has two poles—having reference to the fluid half, or to the metallic (wire) half of the circuit. Take the zinc end—it is positive inwards to the fluid, therefore attracts and combines with oxygen; outwards it is negative, and gives off the electricity. Take the copper, platinum, or carbon end—it is negative inwards to the fluid, and attracts, combines with, or liberates the positive hydrogen, while outwards it is positive. The proof consists in this:—That if you insert a decomposition cell (of water) in the metallic half of the circuit, H is given off towards the negative or zinc pole, while O is given off towards the other end. Or, if electro-plating be the object in view, then copper is attracted or precipitated towards the negative or zinc pole, while the copper plate in connection with the positive end of the battery is oxidised to replenish the solution. The subject is both simple and complex, and much more might be said. The question whether the current passes from the copper to the zinc plate (which way?) is a puzzle which needs ventilation—but more anon.—CHEMICUS.

Hydroxyl.—Positive or Negative?—Hydroxyl is to be found in the new edition of Miller, p. 257; and in Fownes, new edition, p. 260. How, may I ask you, are we to reconcile the formula of Fownes (OH) with the formula for the peroxide of hydrogen (H_2O_2), in the theory that hydroxyl and peroxide of H are one and the same? "Medical Student" may be certain that there is no real difference of opinion as to the poles of a battery; the conductor from the zinc is the negative pole, from the copper the positive. The various modes of expression adopted by authors have for object, either to set forth more clearly the received opinions, or to convey more correct notions. There arises from these various views an *apparent* contradiction at times. But the student will avoid confusion of ideas by means of one or more of the following rules:—1st. See whether there is question of the internal or external part of the voltaic circuit. What occurs inside the battery is, as to the so-called current, the opposite of what occurs outside in the conductors. 2nd. Observe if the author is speaking of the metals in the battery. These may be called *positive* and *negative* (zinc and copper), but their conductors are negative (zinc) and positive (copper); the positive metal is the positive end of the battery, but it is the negative pole. 3rd. Examine the text and context, and, if possible, figure to the mind, mechanically, what is stated; thus, *e.g.*, in Ganot's words, imagine the zinc looking at the copper—it is looking at the positive pole. Again, a little lower down, in the text of Golding Bird, an explanation is given of the tables of negative and positive metals, which explanation clears all difficulty.—E. KERNAN, Clongowes, March 22, 1869.

TO CORRESPONDENTS.

R. G. wishes to be referred to the best work on pottery.

E. Kernan.—We were unable to offer any explanation of the phenomena of the spectrum lines spoken of, and inserted the query in the hope that some correspondent would be able to throw some light on the subject.

Communications have been received from J Spiller; Dr. Adriani; R. Graesser; S. E. Phillips; E. Kernan; H. Stephenson; E. Beanes (with enclosure); W. Jeafferson; F. Andrews; W. L. Sharpe; W. Chapman; F. S. Barry; Archibald Walker and Co.; G. F. Rodwell; R. T. Clarke; W. J. Morgan; A. Baxter; Miss Benwell; J. W. Slater (with enclosure); Dr. R. Oxland (with enclosure).

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ON THE

METHODS AND RECENT PROGRESS OF SPECTRUM ANALYSIS.*

By A. S. HERSCHEL, B.A., F.R.A.S.,
Professor of Natural Philosophy in the Andersonian University of Glasgow.

THE portion of the solar spectrum which is most generally visible under all circumstances of the atmosphere, and in which the bright-line spectra of the metals obtained with the spark of a Rhumkorff coil are most distinctly seen, is that contained between the Fraunhofer's dark lines A and G, at the least and most refrangible ends of the spectrum as it appears in Kirchhoff's maps, the last of which was published in 1863. The air-spectrum between the poles of an induction coil was subsequently employed by Mr. Huggins in his "Researches on the Spectra of some of the Chemical Elements," published in the *Philosophical Transactions* for 1864, as a standard of comparison with the bright-line spectra of the metals produced together with it in the induction spark. The superior heat of the voltaic arc being found to produce more vivid spectra of the elements and to exhibit lines in the violet portion not usually seen with the induction coil, a blue line in the spectrum of lithium was thus first discovered by Professor Tyndall in addition to the orange line which Dr. Bunsen had detected in it by the application of a Rhumkorff coil. To extend Kirchhoff's scale of reference to the wider range of artificial spectra, the labour of completing the map of the solar spectrum by delineating the violet portion, and comparing it with the voltaic spectra of the chemical elements was carried out by Professor Angström with the assistance of Mr. R. Thalén, at Upsala; and the work was published in the *Proceedings of the Stockholm Academy* for February, 1865. Confining their attention chiefly to the iron spectrum produced by two stout iron poles of a Bunsen battery of 50 cells, the specimen of this metal was found to contain so many bright lines, especially in the violet portion, that, in addition to 73 iron lines found by Kirchhoff and Hofmann to have counterparts in the dark solar lines between A and G, about 220 were added to the number in that space and 170 more between G and H, making the whole number of iron coincidences about 460, to which, it was believed, one or two hundred might have been added, had not the short summer and deficient sunlight in the high northern latitude put an end to their comparisons. With a greater battery power and an equally extensive trial of other chemical elements, whose vapours appear to be present in the sun, the probability was suggested that the innumerable black lines of the solar spectrum, which still remain outstanding when those of iron are subtracted, may at length be accounted for without assuming the existence of chemical elements in the solar atmosphere, with which we are unacquainted on the earth. The solar character of four new sodium lines, which were first pointed out and their coincidence with Fraunhofer's lines was suspected by Mr. Huggins in his researches, was confirmed; while the agreement of a prominent dark line about halfway between G and H, designated *h* by the authors, with a fourth line of the spectrum of incandescent hydrogen was established, proving, with the correspondences of the other lines at C, F, and G, the existence of that element in the sun. The metal manganese was placed for the first time on the list of solar elements, and 50 new correspondences of calcium lines were noted in addition to those already previously observed by Kirchhoff. In a Swedish work on spectrum analysis,* published in the following year, Mr. Thalén has compiled a very complete chart of spectra of the chemical elements, referred, like the above-mentioned chart of Mr. Huggins, to the bright lines of incandescent air, and continued, as far as they could be traced, to the violet end of the spectrum. It will easily be perceived that the addition of so many characteristic bright lines in the spectra of the chemical elements, by the use of the voltaic arc, by giving greater certainty to the results, facilitates, in a corresponding degree, the practical applications of the spectroscope. Moreover, in order to establish a natural scale for the uniform representation of artificial spectra, Professor Angström last year published a Normal Atlas of the Solar Spectrum,† in which the wave lengths of the Fraunhofer lines are employed to delineate them, so that the spaces between them represent the differences of their wave lengths enlarged to ten million times their natural dimensions. The most refrangible Fraunhofer line, H, occupies a point at 3,933 millimetres, and the least refrangible line, *a*, a point at 7,185 millimetres on the map, which are ten million times the wave lengths of those lines; and the entire map, consisting of six plates of two lines each, is 11 ft. 6 in. in length. The violet end of the spectrum in this projection is more compressed, and the red end more expanded, than corresponds to their natural appearance. If, however, in place of the wave lengths the number of impulses in a second, or their scale of pitch, as in musical notes, were employed for projecting the Fraunhofer's lines, a nearly natural representation of the prismatic spectrum would be obtained; and the above objection to the use of the normal scale, which may not, however, be of very great theoretical importance, might yet practically be removed with some advantage. A series of elementary bright-line spectra, showing their counterparts among the solar lines, is laid down in the margin of the map, with the following numbers of the corresponding lines of each, in their correct places on the scale, viz.:—Iron, 450; titanium, 116; calcium, 68; manganese, 63; nickel, 35; cobalt, 19; chromium, 18; barium, 10; sodium, 9;‡ magnesium, 7; copper, 7; zinc (blue lines), 2; aluminium (violet lines), 2; hydrogen, 4. By a series of remarkable coincidences, if not of absolute agreements, twenty-four lines of titanium, twenty-one of calcium, and four lines of manganese are represented in the map as corresponding exactly in their positions with iron lines. A similar agreement between a double line of nitrogen and a double line of oxygen was observed by Mr. Huggins in the spectrum of incandescent air,‖ but as the correspondence appeared, on closer examination, not to be absolutely perfect, it was shown to be probably an accidental, although certainly a most curious coincidence. In Angström's Normal Atlas the air spectrum is placed on a parallel line with the solar spectrum, extending throughout its length, so as to include the lines of the elementary spectra between them. The comparison of the latter with either of the two standard scales is, accordingly, made a matter of easy reference. At the end of the atlas is placed a chart of the atmospheric dark lines and spaces of the solar spectrum, a large number of which are now known to owe their presence in it to the absorption produced by aqueous vapour in the earth's atmosphere. This cloudy group of lines is well characterised by Mr. Thalén as forming a faint ground, from which the two solar lines of the

* Abstract of a paper read before the Chemical Section of the Philosophical Society of Glasgow, on Monday, March 1st, 1869.

* "Spectralanalys, Exposé och Historik; Med en Spektrelkarta." Af Rob. Thalén, Upsala, Edquist & Berglund, 1866.

† "Spectre Normal du Soleil;" par A. J. Angström, Upsal, 1868. The plates are drawn by Mr. Thalén.

‡ Three of the new lines of the sodium spectrum are double, like the familiar D line, and the fourth is a narrow nebulous line, making the total number of nine separate bright lines in the spectrum of this vapour.

‖ "Researches on the Spectra of some of the Chemical Elements." *Philosophical Transactions* for 1864, part ii.

inverted metallic spectra, tolerably deep black and well defined, stand out, as if seen in perspective, in strong relief. In place of the four glass prisms used by Mr. Kirchhoff in his researches, a single bisulphide of carbon prism with a refracting angle of 60°, a collimator, and an astronomical telescope, each magnifying forty times, were found to be a sufficiently powerful apparatus to distinguish all the lines shown in Kirchhoff's maps, and to add to them the numerous lines recorded in the above-mentioned drawings by Mr. Thalén. From the foregoing description of their recent publications it will be seen that the operations of the Swedish observers continue to afford fresh data of practical value to spectral analysis, as well as some very important contributions of a novel and interesting kind to spectroscopic science.

ON THE ARTIFICIAL PREPARATION OF ALIZARINE.

At the meeting of the Chemical Society of Belgium on the 24th of February, 1868, MM. Graebe and Liebermann communicated a memoir on alizarine, from which an intimate relation was acknowledged between this colouring matter and anthracene. By heating alizarine, according to M. Baeyer's method, with zinc dust, they obtained, as the sole product of reduction, a hydrocarbon having the composition $C_{14}H_{10}$, and presenting all the qualities of anthracene.

This curious fact caused alizarine to be considered as a derivative of anthracene. It also led MM. Graebe and Liebermann to reject the formula, then very generally allowed for alizarine, $C_{10}H_6O_3$, and to admit for this body the composition $C_{14}H_8O_4$, which they expressed by the rational formula—

$$C_{14}H_6\left\{\begin{matrix}(OH)_2\\(O_2)''\end{matrix}\right\}$$

Having thus obtained anthracene as a product of alizarine, MM. Graebe and Liebermann have since succeeded in solving the inverse problem, that is to say, the artificial preparation of alizarine by means of anthracene. The following account of their new discovery is published by these chemists in the *Rapports de la Société de Chimie de Berlin* (January 11th, 1869).—

"The properties of our product, as well as the colours which it has given us on mordanted cotton, prove the complete identity of artificial alizarine with that from madder root. We submit to the inspection of the Society samples of the colouring matter in a sublimed state, as well as specimens of cotton which have been dyed with this product. The proceedings which led us to this synthesis, and which we shall hereafter describe, confirm the exactitude of the rational formula previously proposed by us for alizarine. It is useless to insist on the importance which our discovery will possess when the means are found to render it universally applicable. The enormous consumption of madder in the printing of tissues, the large tracts of fertile soil made use of for its cultivation, are so many witnesses of the importance which a new trade would have, founded on the artificial preparation of alizarine by means of a material contained in the oil of coal tar."

It appears, according to further accounts from Berlin, that Messrs. Graeger and Liebermann, in order to obtain alizarine from anthracene (paranaphthaline), convert that hydrocarbon into alcohol, and the alcohol into an acid, (lizaric acid and alizarine being synonymous), by acting upon the hydrocarbon with chlorine or bromine, and next effecting a double decomposition by means of acetate of potassa and caustic potassa; after which again an oxidising agent is made to act upon the alcohol so obtained. We think we may state that the gentlemen above named prefer the oxidising action of chlorate of potassa and hydrochloric acid.

RESEARCHES ON GASEOUS SPECTRA IN RELATION TO THE PHYSICAL CONSTITUTION OF THE SUN.*

By Dr. E. FRANKLAND, F.R.S., and J. NORMAN LOCKYER, F.R.A.S.

The authors have carefully studied the spectrum of hydrogen under varying conditions, with a view of detecting whether or not there existed a line in the orange, and to determine the cause to which the thickening of the line F is due. They failed to detect any line in the hydrogen spectrum near the line D. As regards the thickening of the line F, they have convinced themselves that the widening out is due to pressure, and not appreciably, if at all, to temperature *per se*. Having determined that the phenomena presented by the line F were dependent upon and indicated varying pressures, the authors were in position to determine the atmospheric pressure operating in a prominence, in which the red and green lines are nearly of equal width, and in the chromosphere, through which the green line gradually expands as the body of the sun is approached. With regard to the higher prominences, they have ample evidence that the gaseous medium of which they are composed, exists in a condition of excessive tenuity, and that at the lower surface of the chromosphere itself the pressure is very far below the pressure of the earth's atmosphere. The bulbous appearance of the line F may be taken to indicate violent consecutive currents, or local generations of heat, the condition of the chromosphere being doubtless one of the most intense action. According to the hypothesis based upon Kirchhoff's researches and examination of the solar spectrum, the photosphere itself is either solid or liquid, and is surrounded by an atmosphere composed of gases and the vapours of the substances incandescent in the photosphere. Instead of this compound atmosphere, the authors of these researches have found a gaseous envelope, by which nearly, or at all events mainly, the spectrum of hydrogen is given; while the tenuity of this incandescent atmosphere is such, that it is extremely improbable that any considerable atmosphere, such as the corona has been imagined to indicate, lies outside of it. With regard to the photosphere itself, so far from being either a solid surface or a liquid ocean, that it is cloudy, or gaseous, or both, follows both from their observations and experiments.

* Abstract of a paper presented to the Royal Society, February 11th, 1869.

ON THE REFRANGIBILITY OF THE BRILLIANT YELLOW RAY OF THE SOLAR ATMOSPHERE.

By M. G. RAYET.

I have lately been enabled to determine in a very exact manner the position of this brilliant line by means of a very dispersive spectroscope and a fine wire micrometer. By taking, as unity, the distance, D' D'', between the two lines of group D, the number 2·49 is found as equivalent to the distance between the brilliant line at D, and the most refrangible of the D rays. The probable error in this result is less than 0·03.

The brilliant yellow line corresponds to the division 1016·8 of the scale of the Kirchhoff spectrum. Adopting for length of wave of the lines D' and D'' 0·00059053 m.m., and 0·00058988 m.m., that of the brilliant line is 0·00058827 m.m. The yellow line may be seen upon the whole circumference of the solar disc quite as easily as the three lines of hydrogen: the incandescent gas to which it corresponds is therefore of the same character as hydrogen, one of the constituent elements of the solar

atmosphere. At the point where the brilliant ray appears no black line has yet been perceived.

The mode by which I have daily examined the solar atmosphere was as follows:—I employed an equatorial with an object glass, of a focal length of 5 metres, and which was diaphragmed down to 8 centimetres. The telescope was thus rendered quite achromatic, and the difference between the brilliancy of the image of the solar disc and that of its atmosphere was greatly reduced. At the principal focus, where the clear image of the sun fell, was placed the very narrow slit of a direct vision spectroscope; the astronomical telescope, which serves in the latter instrument to examine the spectrum, is movable around an axis which is parallel with the edges of the prisms, and it is quite easy to keep only a small region of the spectrum within the field of vision, namely, that containing one of the brilliant lines. I have also placed between the object glass and the slit of the spectroscope a direct vision prism, itself preceded by a narrow slit. This arrangement is very advantageous as regards a clear view of the yellow line. In this case there is formed an imperfect image a little farther off than the principal focus of the object glass, and from this a determined colour is thrown upon the slit of the spectroscope.—*Comptes Rendus.*

ON NEW EXPLOSIVE POWDERS.

By M. DESIGNOLLE.

(ABSTRACT.)

MANY improvements having lately been made in the art of war, and particularly in the adoption of breech-loading arms, the want has been felt of new powders to meet the requirements of the present artillery. This want has been supplied by M. Designolle, who has invented a new system of powders of which carbazotate or picrate of potash is the base. These powders are of four kinds—viz., a musket powder, gunpowder for short bore cannons, slow gunpowder for cannons with long bores, and an explosive powder for torpedoes and projectiles destined for the undermining of fortifications. The principal advantages of these new powders are the following:—Increase of balistic power without increase of explosive power; the base remaining the same, possibility of regulating and varying the effects between the limits of one to ten; also of regulating, at will, the rapidity of combustion of this powder, and of increasing the balistic power without changing the mode of manufacture. Other advantages are—regularity in the manner of action; suppression of sulphur, and consequently of the vapours of sulphide of potassium and sulphuretted hydrogen; absence of action on metals and almost entire suppression of smoke. Into the explosive powders only two components enter—picrate of potash and nitrate of potash; the musket and gun powders contain carbon in addition to the above-named ingredients. To prepare these powders, the ingredients are beaten from three to six hours with a proportion of water varying from 6 to 14 per cent, according to the nature of the mixture; the powder is condensed by means of the hydraulic press, with a pressure of from 30,000 to 100,000 kilos., graining of the powder, and pressing and drying it according to the methods employed for the black powder. In order to increase the balistic power, the relative proportion of picrate of potash in the mixture must be increased. For musket powder it has been proved that not more than 20 per cent of picrate of potash is required, while for gunpowders its proportion varies from 8 to 15 per cent. This component (picrate of potash) is of a beautiful golden yellow colour, and crystallises into prismatic needles possessing a brilliant reflection; it is insoluble in alcohol, but soluble in about 260 parts of water at 15° or 14 parts of boiling water. Heated with care it becomes orange red at a temperature of 300°, but, on cooling, it assumes its original colour. Heated to 310°, it detonates with violence. The researches of M. John Casthellaz on the action of nitric acid on phenic acid improved the method of manufacturing picric acid, and produced chemically pure picrate of potash at such a reasonable price that the new powders are not more expensive than ordinary black powder.

MM. Designolle and Casthellaz give the following proportions for preparing deflagrating mixtures with coloured flames:—

Golden fire	Picrate of ammonia	50
	Picrate of iron ..	50
Green fire	Picrate of ammonia	48
	Nitrate of barytes	52
Red fire ..	Picrate of ammonia	54
	Nitrate of strontian	46

—*Bulletin de la Société d'Encouragement.*

ON THE IMMEDIATE ANALYSIS OF DIFFERENT VARIETIES OF CARBON.

By M. BERTHELOT.

(Continued from page 148).

III. CARBON SEPARATED FROM ITS DIFFERENT COMBINATIONS.

I extracted carbon from its combinations with hydrogen, chlorine, sulphur, nitrogen, oxygen, boron, and metals, varying as much as possible the conditions of the separation.

1. *Hydrocarbon Combinations.*—These I decomposed by heat alone, by the electric spark, and by chlorine, oxygen, &c.

Heat.—Carbides of hydrogen, decomposed by passing their vapour through a red hot tube, yield amorphous carbon, which has a metallic brilliancy in that part which adheres to the sides of the tube, whilst the central portion is pulverable and soils paper; both will dissolve in the oxidising reagent, but the metallic portion being more coherent, will require a greater number of treatments. Charcoal furnished by benzenic carbides does not differ in this respect from the charcoal of other carbides—similar facts may be here remembered with respect to charcoal from retorts, wood charcoal, and coke.

The Electric Spark.—I have examined the carbon precipitated by this means in the decomposition of marsh gas; it consisted of amorphous carbon and a small quantity of graphite. I believe the amorphous carbon to be due to the proper decomposing action of heat, and the graphite to that of electricity.

Chlorine.—The carbon precipitated from marsh gas by this means was amorphous carbon, similar to that produced by heat.

Iodine and Iodhydric Acid.—Benzine, naphthaline, and several other carbides, heated to 280° for several days, yield a special charcoaly matter, interesting on account of the low temperature at which it is formed. The charcoaly matters contained in benzine and naphthaline both behave in the same manner. They are easily dissolved by an oxidising agent, and form a yellowish brown compound, very emulsionable, easily precipitated by the addition of a salt, and, in fact, nearer than any other to the state of graphitic oxides, without, however, being capable of total assimilation with them. The charcoal derived from benzine retains this property after being calcined to a white heat in hydrogen; but it does not then acquire the power of furnishing a true graphitic oxide.

Products obtained by oxidising benzinic charcoal with pure nitric acid were subjected to special examination; they are soluble in concentrated nitric acid, but if this be diluted with water, a brown resin is precipitated, whilst an analogous substance is suspended in solution. The

first, when dried, becomes brown and fragile; it deflagrates after the manner of graphitic oxides, but contains nitro elements. On treating this insoluble resin with iodhydric acid at 280°, together with the soluble substance, the result was abundance of gaseous carbides and a few liquid carbides. The simultaneous contact of iodine and iodhydric acid at 280° does not then determine either the formation of graphite, or of a charcoal, transformable into graphite by calcination; but at a higher temperature it is otherwise. The charcoal obtained by the decomposition of iodhydric ether in a red-hot tube does, in fact, contain a considerable quantity of graphite, transformable by oxidation into an oxide analagous to that of electric graphite. With regard to carbon in formation at this temperature, iodine presents the same modifying power by which it so easily changes ordinary into red phosphorus, and soluble into insoluble sulphur.

These conditions of carbon and sulphur are precisely those which are affected by the same elements obtained by the decomposition of their chlorinated compounds.

Oxygen.—Lampblack represents carbon precipitated by incomplete combustion, in which heat and oxidation concur; it has been previously shown to consist of amorphous carbon, with a trace of graphite. The first I attribute to the action of heat, the second to oxidation effected at a high temperature.

I have also examined the charcoaly matter produced by the slow combustion of acetylide of copper at the ordinary temperature; it is entirely dissolved by oxidation.*

2. *Chloride of Carbon.*—Upon decomposing the vapour of perchloride of carbon, C_2Cl_4, in a red tube, the charcoaly matter obtained was found to be a mixture of amorphous carbon with a considerable quantity of graphite. The chloride of carbon does not, therefore, furnish the same carbon as marsh gas, notwithstanding the analogy of the formulæ C_2H_4 and C_2Cl_4.

3. *Sulphide of Carbon*, on being decomposed in a red tube, furnishes carbon in thin coherent plates. This carbon contains much graphite, but does not soil paper.

4. *Nitride of Carbon.*—Cyanogen decomposed by the spark only furnishes amorphous carbon with a trace of graphite; the latter I attribute to the influence of the spark.

5. *Carbonic Acid*,—Carbonate of soda is decomposed by heating it with phosphorus. The carbon thus obtained is black and light, and is not attacked by iodhydric acid at 280°. It dissolves by oxidation, leaving a small quantity of graphitic oxide. It may therefore be considered as a mixture of amorphous carbon and graphite.

I also caused sodium to react at a red heat on carbonate of soda; on again taking up the mass with water, the whole dissolves, except a small quantity of carbon, consisting principally of graphite.

6. *Carbide of Boron.*—Carbon is extracted from adamantine boron, by treating it with a current of dry chlorine at red heat. This was effected at two different temperatures—viz., at one inferior to that at which glass is softened, and at one approaching that at which porcelain fuses. In both cases the carbon consisted of graphite, containing no traces of diamond, and transformable into graphitic oxide. The sole difference between the two experiments was that the graphite prepared at dull red heat was amorphous, while that produced at white heat was in hexagonal crystals.

The last-named carbon was deposited partially some distance from where the boron was first placed; this was probably due to the temporary formation of a double chloride of carbon and of boron. Some of the crystals, when examined under the microscope, present the appearance of truncated octahedrons, from the irregular development of their edges; nevertheless, when closely looked at, their form, together with their transformation into graphitic oxide, will remove all doubt.

7. *Carbide of Iron.*—The carbon combined with iron is extracted by two processes—viz., by the action of chlorine at a dull red heat, and with bichloride of mercury. The carbon thus obtained consists in both cases of a mixture of amorphous carbon with a small quantity of graphite. It appears, therefore, that carbon separated from carbides of hydrogen by the action of heat does not contain graphite; while carbon separated from sulphide and chloride of carbon by the action of heat, and from boron by the action of chlorine, contains a considerable proportion of it. Carbon separated from carbonic acid (united with soda) cannot be obtained in a condition equally simple; except in one case, this carbon, isolated either by phosphorus or sodium, also contains a certain proportion of graphite. It is the same with carbon separated from organic compounds by incomplete combustion—that is, by the concurrence of heat and oxidation.

The result of these observations is, that carbon, when separated from hydrogenised combinations, takes the condition of amorphous carbon; whilst that derived from chlorine, sulphur, boron, and perhaps oxygen, inclines to the state of graphitic carbon. Amorphous and graphitic carbons would therefore appear to represent, not different conditions of the carbon itself, but certain polymeric states corresponding with that element.—*Comptes Rendus.*

* The acetylide of copper was prepared with acetylene formed under the influence of the electric arc and by means of its elements. I was able to separate, by means of chlorhydric acid, &c., the charcoaly matter which had formed, after keeping several years.

ON THE WASHING OF PRECIPITATES.*

By Professor R. BUNSEN.

In the process of filtration as hitherto conducted, the time required is so long and the quantity of wash-water needed so great that some simplification of this continually recurring operation is in the highest degree desirable. The following method, which depends, not upon the removal of the impurity by simple attenuation, but upon its displacement by forcing the wash-water through the precipitate, appears to me to combine all the requisite conditions and therefore to satisfy the need.

The rapidity with which a liquid filters depends, *cæteris paribus*, upon the difference which exists between the pressure upon its upper and lower surfaces. Supposing the filter to consist of a solid substance, the pores of which suffer no alteration by pressure or by any other influence, then the volume of liquid filtered in the unit of time is nearly proportional to the difference in pressure: this is clearly shown by the following experiments, made with pure water and a filter consisting of a thin plate of artificial pumice-stone. The thin plate of pumice was hermetically fastened into a funnel consisting of a graduated cylindrical glass vessel, the lower end of which was connected with a large thick flask by means of a tightly fitting caoutchouc cork. The pressure in the flask was then reduced by rarefying the air by means of a method to be described upon another occasion; and for each difference of pressure, p, measured by a mercury column, the number of seconds, t, was observed which a given quantity of water occupied in passing through the filter. The following are the results:—

I.

p. metre.	t. "	pt.
0·179 ..	91·7 ..	16·4
0·190 ..	81·0 ..	15·4
0·282 ..	52·9 ..	14·9
0·472 ..	33·0 ..	15·6

In the ordinary process of filtration, p on the average amounts to no more than 0·004 to 0·008 metre. The advantage gained, therefore, is easily perceived when we can succeed by some simple practicable and easily attain-

* We are kindly permitted by the proprietors of the *Philosophical Magazine* to copy these portions of Professor Bunsen's paper from their number for January, 1869, where the complete paper may be found.

able method in multiplying this difference in pressure one or two hundred times, or, say, to an entire atmosphere, without running any risk of breaking the filter. The solution of this problem is very easy: an ordinary glass funnel has only to be so arranged that the filter can be completely adjusted to its sides even to the very apex of the cone. For this purpose a glass funnel is chosen possessing an angle of 60°, or as nearly 60° as possible, the walls of which must be completely free from inequalities of every description; and into it is placed a second funnel made of exceedingly thin platinum-foil, and the sides of which possess exactly the same inclination as those of the glass funnel. An ordinary paper filter is then introduced into this compound funnel in the usual manner; when carefully moistened and so adjusted that no air-bubbles are visible between it and the glass, this filter, when filled with a liquid, will support the pressure of an extra atmosphere without ever breaking.

The platinum funnel is easily made from thin platinum-foil in the following manner:—In the carefully chosen glass funnel is placed a *perfectly accurately fitting* filter made of writing paper; this is kept in position by dropping a little melted sealing-wax between its upper edge and the glass; the paper is next saturated with oil and filled with liquid plaster of Paris, and before the mixture solidifies a small wooden handle is placed in the centre. After an hour or so the plaster cone with the adhering paper filter can be withdrawn by means of the handle from the funnel, to which it accurately corresponds. The paper on the outside of the cone is again covered with oil, and the whole carefully inserted into liquid plaster of Paris contained in a small crucible 4 or 5 centims. in height. After the mixture has solidified, the cone may be easily withdrawn; the adhering paper filter is then detached, and any small pieces of paper still remaining removed by gently rubbing with the finger. In this manner a solid cone is obtained accurately fitting into a hollow cone, and of which the angle of inclination perfectly corresponds with that of the glass funnel.

Fig. 1 represents the cones. By their help the small platinum funnel is made. A piece of platinum (Fig. 2 shows the natural size) is cut from foil of such a thickness that one square centimetre weighs about 0·154 grm., and from the centre, *a*, a vertical incision is made by the scissors to the edge, *c*, *b*, *d*. The small piece of foil is next rendered pliable by being heated to redness, and is placed upon the solid cone in such a manner that its centre, *a*, touches the apex of the latter; the sides, *a*, *b*, *d*, are then closely pressed upon the plaster, and the remaining portion of the platinum wrapped as equally and as closely as possible around the cone. On again heating the foil to redness, pressing it once more upon the cone, and inserting the whole into the hollow cone and turning it round once or twice under a gentle pressure, the proper shape is completed. The platinum funnel, which should not allow of the transmission of light through its extreme point, even now possesses such stability that it may be immediately employed for any purpose. If desired, it may be made still stronger by soldering down the overlapping portion in one spot only to the upper edge of the foil, by means of a grain or two of gold and borax; in general, however, this precaution is unnecessary. If the shape has in any degree altered during this latter process, it is simply necessary to drop the platinum funnel into the hollow cone and then to insert the solid cone, when, by one or two turns of the latter, the proper form may be immediately restored. The platinum fuunel is placed in the bottom of the glass funnel, the dry paper filter then introduced in the ordinary manner, moistened, and freed from all adhering air-bubbles by pressure with the finger. A filter so arranged and in perfect contact with the glass, when filled with a liquid, will support the pressure of an entire atmosphere without the least danger of breaking; and the interspace between the folds of the platinum-foil is perfectly sufficient to allow of the passage of a continuous stream of water.

In order to be able to produce the additional pressure of an atmosphere, the filtered liquid is received in a strong glass flask instead of in beakers.* This flask is closed by means of a doubly perforated caoutchouc cork, through one of the holes of which the neck of the glass funnel is passed to a depth of *from 5 to 8 centimetres* (fig. 3); through the other is fitted a narrow tube open at both ends, the lower end of which is brought *exactly to the level of the lower surface of the cork*, to the other is adapted the caoutchouc tube connected with the apparatus (fig. 4) destined to produce the requisite difference in pressure; this apparatus will be described immediately. The flasks are placed in a metallic or porcelain vessel (fig. 3), in the conical contraction of which several strips of cloth are fastened. This method of supporting the flask has the advantage that, in one and the same vessel, flasks varying in size from 0·5 to 2·5 litres stand equally well, and that, by simply laying a cloth over the mouth of the vessel, the consequences of an explosion (which through inexperience or carelessness is possible) are rendered harmless.

It is impossible to employ any of the air-pumps at present in use to create the difference in pressure, since the filtrate not unfrequently contains chlorine, sulphurous acid, hydric sulphide, and other substances which would act injuriously upon the metallic portions of these instruments. I therefore employ a *water* air-pump constructed on the principle of Sprengel's mercury-pump, and which appears to me preferable to all other forms of air-pump for chemical purposes, since it affects a rarefaction to within 6 or 12 millimetres pressure of mercury.

Fig. 4 shows the arrangement of this pump. On opening the pinchcock, *a*, water flows from the tube, *l*, into the enlarged glass vessel, *b*, and thence down the leaden pipe, *c*. This pipe has a diameter of about 8 millims., and extends downwards to a depth of 30 or 40 feet, and ends in a sewer or other arrangement serving to convey the water away. The lower end of the tube, *d*, possesses a narrow opening; it is hermetically sealed into the wider tube, *b*, and reaches nearly to the bottom of the latter. A manometer is attached to the upper continuation of this tube, *d*, by means of a side tube at d_1; at d_2 is attached a strong thick caoutchouc tube possessing an internal diameter of 5 millims. and an external diameter of 12 millims.; this leads to the flask which is to be rendered vacuous, and is connected with it by means of the short narrowed tube, *k*. Between the air-pump and the flask is placed the small thick glass vessel, *f*, in which, when one washes with hot water, the steam which may be carried over is condensed. All the caoutchouc joinings are made with very thick tubing, the internal diameter of which amounts to about 5 millims., the external diameter to about 17 millims. The entire arrangement is screwed down upon a board fastened to the wall, in such a manner that each separate piece of the apparatus is held by a single fastening only, in order to prevent the tubes being strained and broken by the possible warping of the board. On releasing the pinchcock, *a*, water flows from the conduit, *l*, down the tube, *c*, to a depth of more than 30 feet, carrying with it the air which it sucks through the small opening of the tube, *d*, in the form of a continuous stream of bubbles. No advantage is gained by increasing the rapidity of the flow, since the friction exerted by the water upon the sides of the leaden pipe acts directly as a counter pressure, and a comparatively small increase in the rapidity of the flow is accompanied by a great increase in the amount of this friction. Accordingly, at *g* is a second pinchcock, by which the stream can be once for all so regulated that, on completely opening the cock, *a*, the friction, on account of the diminished rate of flow, is rendered sufficiently small to allow of the maximum degree of rarefaction. Such an apparatus, when properly regulated once for all by means of the cock, *g*, exhausts in a comparatively short time the largest vessels to within

* These flasks must be somewhat thicker than those ordinarily used, in order to prevent the possibility of their giving way under the atmospheric pressure.

a pressure of mercury equal to the tension of aqueous vapour at the temperature possessed by the stream.* The tension exerted by the water-stream in my laboratory, in which six of these pumps are used, amounts to about 7 millims. in winter and 10 millims. in summer. The filtration is made in the following manner:—The flask standing in the metallic or porcelain vessel (fig. 3) is connected by means of the slightly drawn-out tube, *k*, with the caoutchouc tube, *h*, attached to the pump, the cock, *a*, having been previously opened and the properly fitted moistened filter filled with the liquid to be filtered. As usual, the clear supernatant fluid is first poured upon the filter; in a moment or two the filtrate runs through in a continuous stream, often so rapidly that one must hasten to keep up the supply of liquid, since it is advisable to maintain the

Fig.2.

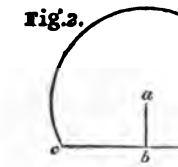


Fig.4.

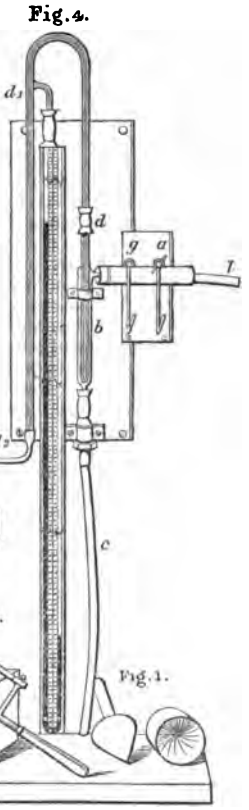


Fig.5.

Fig.3.

Fig.6.

Fig.1.

filter as full as possible. After the precipitate has been entirely transferred, the filtrate passes through, drop by drop, and the manometer not unfrequently now shows a pressure of an extra atmosphere. The filter may be filled (in fact, this is to be recommended) with the precipitate to within a millimetre of its edge, since the precipitate, in consequence of the high pressure to which it is subjected, becomes squeezed into a thin layer, broken up by innumerable fissures. As soon as the liquid has passed through, and the first traces of this breaking up become evident, the precipitate will be found to have been so firmly pressed upon the paper, that, on cautiously pouring water over it, it remains completely undisturbed. The washing is effected by carefully pouring water down the side of the funnel to within a centimetre *above* the rim of the filter: the washing-flask for this purpose is not applicable; the water must be poured from an open vessel.

* The time required to obtain the above degree of exhaustion in a flask of from 1 to 3 litres capacity ranges from 6 to 10 minutes; the quantity of water necessary amounts to about 40 or 50 litres.

After the filter has in this manner been replenished four times with water and allowed to drain for a few minutes, it will be found to be already so far dried, in consequence of the high pressure to which it has been subjected, that without any further desiccation it may be withdrawn, together with the precipitate, from the funnel, and immediately ignited, with the precautions to be presently given, in the crucible.

If the porosity of a paper filter containing a precipitate were as unalterable as that of a pumice-stone filter, the experiments above described would show that the times required for filtration, according to the old method on the one hand, and the new one on the other, would be inversely proportional to the difference in pressure in each case; that is, by using the pump under the full pressure of about 740 millims., the time needed to wash a precipitate, occupying by the old process an hour, would at the utmost not amount to more than 30 seconds. In using these pumice filters (about which I will speak presently) to drain crystals from adhering mother-liquors, or, say, to wash crystals of chromic acid by means of concentrated sulphuric acid and fuming nitric acid, the time occupied in the filtration is scarcely longer than that needed to pour a liquid slowly from one vessel to another. In filtering by means of paper, the precipitate gradually closes up the pores of the filter, and accordingly such an extraordinary acceleration as this can no longer be expected. But the following examples will show the saving of time and labour the method effects, even under all unfavourable conditions. For these experiments I have purposely chosen the hydrated chromium sesquioxide, since it is one of the most difficult of precipitates to wash thoroughly. A solution of chromium chloride was prepared by acting with fuming hydrochloric acid upon potassium dichromate; and by means of a measuring vessel, which allowed the amount of chromium to be estimated to within 0·0001 grm., successive portions of the liquid were withdrawn, and the chromium oxide contained in them precipitated with the usual precautions by ammonia. The volume of liquid, the quantity of ammonia employed, the time occupied in boiling and in permitting the precipitate to settle, the angle of inclination possessed by the funnel, and the size of the filter were the same in all the experiments. All the precipitates were washed with hot water, and, after burning the filter, ignited over the blowpipe for a few minutes; in weighing, the platinum crucible was tared by one of about equal weight, and the position of equilibrium of the beam determined by vibrations.

(To be continued.)

Reducing Aluminium from its Ores.—Mr. A. L. Fleury, of Boston, U.S., mixes pure alumina with gas tar, resin, petroleum, or some such substance, making it into a stiff paste, which is divided into pellets, which are dried in an oven, then placed in a strong retort or tube, which is lined with a coating of plumbago. They are then exposed to a cherry-red heat. The retort must be sufficiently strong to stand a pressure of from 25 to 30 lbs. on the square inch, and be so arranged that, by means of a safety valve or tube, the necessary amount of some carburetted hydrogen gas can be introduced into the retort among the heated mixture, and the pressure of from 20 to 30 lbs. on the square inch be maintained. The gas alluded to is forced into the retort by means of a force pump. By this process the alumina is reduced and the aluminium remains as a spongy mass, mixed with carbon. This mixture is re-melted with metallic zinc, and when the aluminium has collected in a metallic state the zinc is driven off by heat. The reduction is due to the carburetted hydrogen gas under pressure. The time required for reducing one hundred pounds of alumina earth, cryolite, or other compound of alumina, should not be more than four hours; when the gas can be applied in a previously heated as well as strongly compressed state, the reduction takes place in a still shorter period.

INFLUENCE OF THE OXIDES OF CHROMIUM AND TITANIUM ON THE COMPOSITION OF PIG-IRON.

By AUG. A. and S. DANA HAYES,
Assayers to State of Massachusetts.

WITHIN the last four years we have been frequently employed in chemical investigations of the altered characters of some pig-irons, which resulted apparently under the usual circumstances in the reduction of uniform ore.

In these cases the amount of carbon united with the iron had been diminished, without the introduction of other matter, in quantity sufficient to influence a change in this connection, and generally no variation in the composition of the ore was known or suspected. We had analysed the ores in some of the beds in former years and regarded them as well adapted to the production of pig-iron of good quality; but in pursuing the research we were convinced that the change in quality of iron could be traced to altered composition in the ore of part of the beds used for supplying the furnaces.

The correctness of this view was confirmed by our analyses of many iron ores, in some of which we found the oxides of chromium or titanium existing where they were not indicated and connected with the ore in beds which have been considered as pure iron ores.

Both the oxide of chromium and oxide of titanium seem to act in the furnace or the crucible in a way to withdraw a portion of the carbon, or prevent that true union of carbon with a portion of the iron, which constitutes grey pig-iron, without the metals of these oxides really alloying with the iron and thus indicating the cause of change. We have analysed samples of pig-iron where the alloys of chromium or titanium existed in the pigs, and where the oxides accompanied the ores in the beds, but we were not prepared to find an influence exerted on the quality of the pig metal without the refractory metals forming a part of the composition.

The occurrence of oxide of manganese with iron ore is common, and titanium compounds are often found in both magnetic and brown iron ores, as insoluble substances, in small proportions, and these compounds combine with and are removed by the fluxes without injury to the pig metal. These compounds of titanium are the cause of the often superb blue colour of the cinder, produced under varying conditions of glassy or stony character, and must be carefully distinguished from those we regard as more detrimental in their influence on the metal.

In a number of analyses of iron ores we had found both oxide of chromium and oxide of titanium in a state rendering them soluble in diluted acids, and in a condition to escape detection in the ordinary modes of analysis. Both magnetic and brown iron ores have been found to contain either oxide of chromium or oxide of titanium in this soluble state. Among the samples from contiguous beds, this diversity in composition made by the presence of some oxide of chromium or oxide of titanium existed; and while the bulk of a bed of ore was pure, continuations of the bed or associated ore yielded notable weights of oxide of chromium or oxide of titanium in the different samples.

The suggestion we would make to the iron-master in view of these facts, is the possibility of the quality of the pig metals in anomalous cases being greatly influenced by the admixture of some ore containing the oxides of chromium or titanium with the basis ore of good quality. This may take place by the main bed being crossed by veins of mixed ore, or by the workings passing into contiguous beds where one kind of ore is used. In other cases, where the iron the master can gain a great udvantage arising from mixing ores, one of the kinds may contain the contaminating oxides and injure the iron.

We subjoin some results of analyses, showing the proportion of oxide of chromium to the metallic iron contained in the ores:—

1st. Magnetic ore—iron, 49; oxide of chromium, 1·40.
2nd. Hæmatite ore—iron, 42·47; oxide of chromium, 1·60.
3rd. Brown Massive ore—iron, 54·32; oxide of chromium, 1·90. 4th. Same—iron, 46·70; oxide of chromium, 1·04.

More traces have been discovered in some cases, while in other instances a larger proportion of chromium formed an alloy with the iron produced from the ore.—*Scientific American.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, March 18th, 1869.

(Continued from p. 153).

Dr. WARREN DE LA RUE, F.R.S., President, in the Chair.

MR. E. T. CHAPMAN read an abstract of a paper by himself and Mr. Miles H. Smith "*On the Butylic Compounds derived from Alcohol by Fermentation.*" The authors had operated on about 17 gallons of London fusel oil. After subjecting it to a series of fractional distillations, they obtained about five litres of a body boiling within some 3-10ths of a degree; this body consisted of butylic alcohol, contaminated with small quantities of iso-butylic alcohol. The distilling vessel consisted of a tin can of two gallons capacity; its neck was closed by a cork, through which passed a wide glass tube, bent twice at an obtuse angle. From this butylic alcohol, the authors prepared the iodide, bromide, nitrate, acetate, and nitrite of butyl, from which the iso-butyl compounds are separated by fractional distillation.

Iodide of Butyl is a clear, colourless, mobile liquid, boiling constantly at 121°. Its specific gravity is—at 0°, 1·6301; at 16°, 1·6032; at 50°, 1·54816. Ten thousand volumes at 0° become, at 16°, 10,168; and at 50°, 10,529. Instead of heating the crude butylic alcohol with iodine and phosphorus, the authors prepare it by boiling the crude alcohol with four times its volume of hydriodic acid of specific gravity about 1·8. The iodide which separates from the acid is run into a flask containing carbonate of soda and water. The mixture is distilled, and the colourless iodide separated and dried with chloride of calcium and fractionally distilled. It possesses in a high degree the property of splitting up into hydriodic acid and olefine.

Bromide of Butyl is best obtained by saturating the alcohol with gaseous hydrobromic acid. The saturated solution is mixed with its own volume of aqueous hydrobromic acid (sp. gr. 1·6); it is then gradually heated in closed vessels to the boiling point. When the oily layer ceases to increase, the bromide is separated from the acid and distilled with a dilute solution of carbonate of soda; the oily liquid is then separated from the water, dried over chloride of calcium, and fractionally distilled. Its specific gravity is 1·2702 at 16°.

Nitrate of Butyl boils at 123°. Its specific gravity is 1·020 at 16°, and it closely resembles nitrate of amyl. To prepare it, 100 c.c. of a mixture consisting of two volumes of sulphuric acid and one of nitric acid (sp. gr. 1·4) are placed in a beaker standing in cold water and ice. About 30 c.c. of the alcohol are slowly conveyed by means of a tube beneath the surface of the acids, which must be constantly stirred: the nitrate which rises to the surface is decanted into a retort and distilled; it is then separated from the water and dried with chloride of calcium, and if the alcohol was not pure it must be fractionally distilled.

Nitrite of Butyl is a yellow mobile liquid, boiling at about 67°. It is obtained by slowly passing nitrous acid into butylic alcohol, which is kept cool with water. When saturated, the nitrite is washed with water, with dilute caustic potash, and again with water; it is then dried

over chloride of calcium and fractionally distilled. Its specific gravity is at 0°, 0·89445; at 16°, 0·8771; and at 50°, 0·82568; therefore 10,000 volumes at 0°, become 10,198 at 16°, and 10,833 at 50°. One hundred parts of butylic alcohol may be made to yield from 105 to 110 of the nitrite.

Acetate of Butyl is prepared by mixing crude butylic alcohol with glacial acetic acid, saturating with HCl, warming in the water bath, and washing with cold water. The washings are distilled, the distillate treated with carbonate of potash, the oily layer separated and treated again with glacial acetic and hydrochloric acids, and then washed. The acetate is now carefully dried; first by agitation with carbonate of potash, and then by long standing over a new portion of the freshly ignited carbonate; it is then fractionally distilled. Acetate of butyl boils at 117·5; its specific gravity is 0·89096 at 0°, 0·8747 at 16°, and 0·83143 at 50°. Ten thousand volumes at 0° become 10,186 at 16°, and 10,716 at 50°.

Butylic Alcohol.—The authors obtained this most readily by pouring the pure acetate upon about half its weight of caustic soda. After awhile, the mixture boils violently, when it is cooled by immersing the vessel in cold water; water is now added, and the whole distilled. The distillate consists of butylic alcohol, acetate of butyl, and water; it is now saturated with carbonate of potash, the oily portion decanted, and again treated with caustic soda. The mixture is now treated with water and again distilled, the distillate treated as before with carbonate of potash, then thoroughly dried by boiling with and allowing it to cool over carbonate of potash. It must then stand over a large quantity of caustic lime for some weeks, or be digested with it for twelve or fourteen hours, at a temperature between 65° and 75°. On distilling it off the lime, it is perfectly dry; it boils at 108½ at the normal pressure, going quite to dryness below 109°. It was found that it could not be dried with sodium.

Mercury Butyl is easily prepared by the general method given by Frankland and Duppa for the preparation of the mercury compounds of the alcohol radicals. Five grammes of sodium are dissolved in 2,000 grammes of mercury, and agitated with an equivalent quantity of iodide of butyl, to which 1-10th of its weight of acetic ether has been added. The mixture is well shaken; great heat is given out during the reaction. When the bottle is nearly cold, the remaining mercury is poured out in a clean state, and again treated with iodide of butyl and acetic ether. This process is continued till a sufficient quantity of crude mercury butyl is obtained: it is then subjected to distillation. The distillate consists of two layers, the lower of which is mercury butyl, contaminated with iodide of butyl and acetic ether; these are separated by driving a current of steam through it, until no iodine can be detected. The water is then separated, and the compound dried with chloride of calcium. So prepared, mercury butyl is a colourless, transparent liquid of specific gravity 1·7192 at 16°. It cannot be distilled by itself; but it will stand a temperature of 130° without much decomposition.

The authors state that the butyl spoken of throughout the paper, is iso-propyl-methyl; and the alcohol in Kolbe's nomenclature, iso-propyl carbinol; and that the alcohol yields on oxidation iso-butylic acid. The authors base their assertion that they are dealing with butyl compounds on a combustion of the alcohol. Burnt with chromate of lead, 0·3507 gramme of the alcohol yielded 0·8348 gramme of carbonic acid, and 0·440 gramme of water, the following percentages of carbon and hydrogen are calculated:—

		Theory.
C_4	64·92	.. 64·87
H_{10}	13·94	.. 13·51
O	—	.. 21·62

A combustion of the iodide obtained from the alcohol was also made. Burnt with chromate of lead and copper turnings, 0·844 gramme of the iodide yielded 0·807 gramme of carbonic acid, and 0·3775 of water. Three iodine determinations were made on three different samples of the iodide prepared at different times: 1·257 grammes yielded 1·6016 of iodide of silver; 0·6904 gramme yielded 0·8839; and 0·8830 of iodide yielded 1·1253 of silver. The following are the percentages calculated:—

			Theory.
C_4	26·08	.. ..	26·09
H_9	4·97	.. ..	4·89
I	68·97	(mean)	69·02
	100·02		100·00

The iodide was also titrated in the manner described by Professor Wanklyn, the digestion being carried on in sealed tubes.

The atomic weights of propyl, butyl, and amyl being $C_3H_7=43$, $C_4H_9=57$, $C_5H_{11}=71$, the authors conclude that a determination of the atomic weight at once points out with which radical they are dealing.

The atomic weights, as deduced from the iodine determinations, are—(I.) 57·43; (II.) 56·55; (III.) 57·4. The atomic weights deduced from the titrations are—(I.) 56·05; (II.) 56·76.

The PRESIDENT said that Mr. Chapman had evidently arrived at some very interesting results, and there were many gentlemen present who were familiar with the investigations made in the same line by Würtz and Butlerow. It was very essential to distinguish between the primary, secondary, and tertiary alcohols, and a discussion of the various points brought forward might eliminate some of the discrepancies which appeared to exist in the physical properties of the substances described by Mr. Chapman and his predecessors. There was evidently some difference as to boiling points and specific gravities, and they were not quite sure they were speaking absolutely of the same substances.

Dr. ODLING corroborated the President's remarks as to the importance of forming a classification of alcohols, and to obtain reactions, by which the class to which an alcohol belonged might be readily identified. He rather objected to some of the definitions occasionally given of alcohols and other bodies in text-books. The definition should be that it is a body which behaves in a particular manner, from which its composition is afterwards inferred. An alcohol which, when oxidised, yields an acid belonging to the ordinary fatty series, is classed as a primary alcohol on that ground; and that is a reaction, or a kind of fact, upon which a definition may be directly based. With regard to classification, he preferred to represent the alcohol on the hydrocarbon from which it was derived as containing the one residue CH, and associated with that the residue CH_3 taken three times, $CH(CH_3)_3$. The residue CH_3 undergoes that modification in which the hydrocarbon is changed into the alcohol, so that if represented fully it would be

$$CH\begin{cases}CH_3\\CH_3\ OH\\CH_2\end{cases}$$

They were acquainted with alcohols in which the residue CH_3 occurs twice and three times, and perhaps only once. If CH_2 was replaced by peroxide of hydrogen, he should consider it a primary alcohol. When one of the H's was replaced by OH, he considered it a secondary alcohol, and the final H being replaced by OH would make it a tertiary alcohol. Mr. Chapman called his alcohol a primary alcohol, because CH was replaced by peroxide of hydrogen, therefore there would be three different classes of primary alcohols, one which contained one, another with two, and a third with three CH.

Professor WANKLYN preferred to classify according to the linking, and to have criteria by which to recognise the linking. The criterion by which a primary alcohol was recognised was, that by oxidation, it gave an acid containing the same number of atoms of carbon as the alcohol itself. By oxidation, the alcohol Mr. Chapman had obtained gave isobutylic acid, which has the same number

of atoms of carbon as the alcohol. This alcohol would be called a pseudo-primary, or an iso-primary alcohol; the proof that it was not the normal butylic alcohol was that the acid formed was not the common butylic acid, but the isobutylic.

Dr. ODLING: What is the proof that the common butylic acid is not the isobutylic, and this the common?

Professor WANKLYN said the proof was two or three years old. Butylic ether, boiled at 119°, isobutylic at 112°. The lime salt of one was more soluble than that of the other.

Dr. ODLING thought Mr. Wanklyn did not understand his question. He asked for the proof that the particular formula applied to the acid Mr. Chapman had obtained, and not to the ordinary?

Mr. WANKLYN said there was a difference in the reaction, and therefore a different formula must be written to express it.

Dr. ODLING would not for a moment be understood to doubt the correctness of the formula, but Mr. Wanklyn had not taken the point of his question. There were two distinct butylic acids, and two distinct butylic alcohols, in addition to a great many more; how did Mr. Wanklyn know that the formula *a* applied to the compound *a*, and not to the compound *b*, and *vice versa*?

Mr. WANKLYN replied that, in addition to the different reactions, there was the synthetical proof. Isobutylic acid might be made from cyanide of isopropyl, and the synthetical proof of the composition of isopropyl gave synthetical proof of the composition of isobutylic acid.

Mr. CHAPMAN said there was also the analytical proof. Isobutylic acid would break up in oxidation while the normal did not. He did not quite agree with Dr. Odling's proposed formulæ. If they had only primary, secondary, and tertiary alcohols to deal with, they only wanted criteria to distinguish those three, and his method of viewing them had the advantage of presenting at one view what was the possible number.

Dr. ODLING observed that, with regard to formulæ, it was a mere matter of preference and convenience which was adopted. As to the other point, Mr. Wanklyn misunderstood his expression. It was not the classification he objected to, but the definition. As a matter of logic, the definition should have reference to the criterion as nearly as possible, so that, in saying whether this body belonged to the *a* or the *b* class, the great thing was to see whether it behaved in a particular way.

Dr. CRUM BROWN felt very strongly the importance of classifying substances and ideas rather according to facts than the particular way in which one might choose to represent the facts. An alcohol was a body which had certain reactions when treated with acids; some yielded by a particular process an aldehyd; some, by oxidation, yielded an acid; then let them be classified by the way in which they yielded these. Let there be a functional classification of alcohols as well as of aldehydes and acids, and then they would get an inverse operation to represent the different classes of alcohols, and get rid of the danger which attended the free use of the atomicity theory. This theory did not seem to be in harmony with the general dynamical principles of science, and therefore it must be replaced by a theory which would have a true place in physics.

Mr. WANKLYN desired to say that in order to classify, it was necessary to co-ordinate the facts. They could only make out what were the relative values of the facts by the theory, and to proceed rationally they must classify from theory, and not from facts.

Dr. GUTHRIE wished to ask Mr. Chapman what was the precise origin of the fusel oil, upon which he had worked. One of the earliest instances of isomerism, viz., the two amylic alcohols, was discovered by Pasteur in working with fusel oil; and therefore Mr. Chapman should have mentioned the precise origin of this fusel oil, whether from potato or grain spirit.

Mr. CHAPMAN was very sorry that he could not answer that question. Distillers were not given to impart information. In many distilleries mixed grains were employed, and therefore it would be difficult to answer Dr. Guthrie's question. The alcohol and the fusel oil were mixed before he had it, so he could not answer with any certainty what the matter was. He had, however, examined many other specimens of fusel oil, and they all gave symptoms of containing butylic alcohol. If it was found that on treating normal iodide with alcoholic potash no butyl compound was evolved, and that on treating the isopropyl carbinol with alcoholic potash, butylene was evolved, they would have fair ground for making a wide division of the alcohols, and perhaps be justified in calling them hydrates of olefines and alcohols. He wished that the Society would use its influence to obtain a careful arrangement of the already-known chemical data.

The PRESIDENT, in thanking Mr. Chapman for his paper, said that he could not see there would be any good result in promoting the experiments he had proposed. If there was anything treacherous as a basis on which to found an idea of the purity of compounds, it was the boiling point and specific gravity. Seven years experience of his own, which was followed up by Dr. Miller, had led him to the conclusion that they could not place the slightest reliance on them.

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

A MEETING was held in the Upper Hall of the Glasgow Art Gallery on Monday, the 29th inst., at eight o'clock in the evening, W. R. Hutton, Esq., in the chair.

Two new members were admitted by ballot, and one candidate was proposed.

The following papers were read:—"*On the Examination of the Flame of the Bessemer Converter*," by THOMAS ROWAN, Esq., F.C.S; "*On the Effect of Phosphorus on Iron*," by THOMAS ROWAN, Esq., F.C.S.; "*On the Quality of Compound Molecules*," by J. CAMERON, Esq. We intend to give a further notice of these papers as space permits.

NEWCASTLE CHEMICAL SOCIETY.

THE fourth general meeting of the Society was held on the 25th inst., the President in the chair.

Seven new members were elected. Dr. LUNGE read "*Notes on the Progress of Foreign Analysis during* 1868." Mr. J. W. SWAN exhibited and described a powerful Holz induction machine.

NOTICES OF BOOKS.

Mémoire sur la Composition Chimique des Monneries Néerlandaises et sur la Volatilisation de l'Argent. Par A. D. VAN RIEMSDIJK, Docteur es Sciences. Pp. 38.

THIS is an abstract, reprinted and separately published from the "Archives Néerlandaises," vol. iii., 1868. The larger work was written and published in Dutch early last year. It treats on a subject which can only satisfactorily be experimentally studied in a well arranged Mint; and Dr. Van Riemsdijk, having that opportunity at Utrecht Mint, has thoroughly gone into matters with great zeal and industry. It will be clear, even to a casual observer, that divers chemical changes must of necessity occur to the alloys intended to be converted into coin during the many operations the alloy is submitted to before it leaves the works; it is simply impossible to melt together two metals, and afterwards again anneal the partly rolled out bars, without some chemical change being called into

play. The various changes and effects also of the blanching and cleaning of the alloys have been studied and experimented upon by the author: he has extended his experiments not only to Netherlands, but also to Belgian, French, Peruvian, Bolivian, and Chilian silver coins. Gold coins are not made at the Utrecht Mint as current Netherland coins; hence no experiments were made with gold. The author has also investigated the capability of silver, both pure and alloyed, for absorbing and occluding various gases, especially hydrogen and oxygen gas. On the whole, those who work in silver on the large scale, and are interested in the real composition and constitution of the alloyed metal, will find in this paper many very interesting and useful hints, while assayers will certainly read with pleasure the information contained in these pages.

The Voice, and How to Use it. By Charles James Bishenden, Professor of Singing. London: Published at 52, Mortimer Street, Cavendish Square.

This pamphlet treats entirely of the cultivation and preservation of the voice for singing. The author, who has well studied his subject, not only enters fully into the course of practice required, but describes the mechanism of the vocal organs, showing clearly and intelligently the influence they exert; he also recommends careful attention to the diet, which greatly affects the development and power of the voice.

CORRESPONDENCE.

THE NON-PRECIPITATION OF SULPHIDE OF MANGANESE.

To the Editor of the Chemical News.

Sir,—In the short communication which Professor How, of Nova Scotia, addressed to you last week, entitled "On the Non-Precipitation of Manganese by Sulphide of Ammonium in presence of some Organic Ammoniacal Salts," your correspondent evidently writes under the impression that the remarkable behaviour of this metal under the circumstances mentioned by him has not been previously noticed or described, and in giving you his results he naturally refers to them as "possessing novelty and interest." I have, however, to request the favour that you will allow me to point out the fact that the reactions in question formed part of a communication which I read at a meeting of the Chemical Society of London as far back as the 16th of March, 1857. My paper (of ten pages) contains a long inventory of cases in which citric, tartaric, and other organic acids were found to exert important influences on a variety of chemical reactions; and in the title, I specifically referred to these effects as "remarkable circumstances tending to disguise the presence of various acids and bases in chemical analysis." One of the most striking anomalies observed by me was the non-production of the ordinary precipitate upon mixing chloride of barium with a soluble sulphate, when an alkaline citrate was present in the same solution.

The sulphides of manganese, arsenic, and platinum were those which showed to the greatest extent the interfering action of the citrates, and the effect of tartaric acid was observed as being exerted in the same direction. I quote from the *Quarterly Journal of the Chemical Society* two or three paragraphs descriptive of the modified reactions of manganese:—

"*Oxide of Manganese.*—The most striking result observed under this head relates to the behaviour of the *sulphide*. The flesh-coloured precipitate usually obtained on adding sulphide of ammonium to a salt of manganese does not appear under these circumstances, and the sulphide, after precipitation, is freely soluble in an alkaline citrate. If citrate of ammonia be the solvent employed, vapour of sulphide of ammonium is evolved on boiling. The protoxide of manganese is not precipitated by potassa, nor the carbonate by carbonate of soda, in presence of a soluble citrate."

. . . . . .

"*Tartaric acid* prevents the precipitation of a salt of cobalt by potassa, and, in the form of a neutral tartrate, retains in solution sulphate of lead and the *sulphide of manganese*. Prussian blue is not formed in its presence; and the precipitation of sulphate of baryta is to a small extent retarded."

"*Grape sugar*, likewise, prevents, in the cold, the formation of *sulphide of manganese*. Neither cane nor milk-sugar appeared to have any influence in this direction."

It will be seen, therefore, that although the results of Professor How are undoubtedly interesting, they fail to possess also the charm of novelty. Many an old fact has gained importance by being recited, and I think that the suggestion of the interference being due to the production of manganos-ammonium may possibly receive confirmation from the parallel circumstances observed in the case of arsenic, with the alternative of referring them, in other cases, to the existence of a class of double citrates, as indicated in my paper twelve years ago.—I am, &c.,

John Spiller.

London, March 22nd, 1869.

THE CHEMISTRY OF SUGAR REFINING.

To the Editor of the Chemical News.

Sir,—In your issue of this week, there is a letter from Mr. E. Beanes, which seems to call for a brief reply from me.

Mr. Beanes makes it appear that I "announced" the fact that "acids invert cane sugar" as an original observation, and rejoices in having known it for the last thirty years. I need scarcely state that "the fact" is one of the first with which students of organic chemistry are made acquainted.

Mr. Beanes further states that "our refiners load with calcic carbonate the very carbon surface upon which they depend for the decolourisation of their syrups!" This is, as applied to British refiners, simply absurd. The calcic carbonate, which is not an impurity, as Mr. Beanes states, but an essential constituent of animal charcoal, continually decreases with use, and, occasionally, almost entirely disappears.—I am, &c.,

William Wallace.

Glasgow, March 27th, 1869.

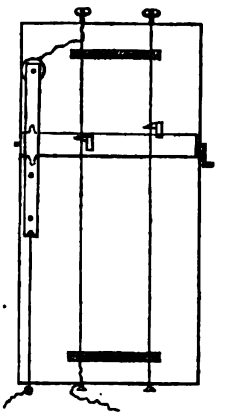
NOTES ON LECTURE EXPERIMENTS.

Sudden Crystallisation.—I think your correspondent "Crystal" would get over his difficulty best by abandoning the large flask and employing a flat medicine bottle full of the solution. This is used as a magic-lantern slide—that is, it is strongly illuminated, and an image formed upon a screen with the aid of a convex lens. I have shown the experiment to very large audiences by employing this method.—Alfred H. Allen, 1, Surrey Street, Sheffield.

Apparatus for Showing the Reciprocal Nature of Combustion.—I have taken much interest in Mr. Woodward's descriptions of lecture experiments, and it affords me great pleasure to be be able to help him. The apparatus I employ for showing the reciprocal nature of combustion is modified from that described in Bloxam's "Chemistry." It consists of a paraffin-lamp glass, placed in an erect position and closed at both ends by perforated corks. Through the lower cork pass a narrow glass tube, for the admission of coal gas or hydrogen, and a wide tube of brass extending about half an inch on each side of the cork. The upper end of the lamp glass has a perforated cork and short glass tube, to serve as an exit for the products of combustion. This seems to be missing in Mr. Woodward's apparatus. The coal gas is first turned on full and lighted at top and bottom, and then, by diminishing the supply of gas, a flame of air is obtained at the interior end of the brass tube, and may be exchanged

for oxygen or chlorine at pleasure. By blowing out the upper flame, the apparatus shows the production of acetylene, and by extinguishing the air flame, it affords a good illustration of the theory of the Bunsen flame. No moisture is deposited, the air flame burns continuously, and frequently produces a musical note. Mr. Woodward should admit his coal gas below, and have an exit tube above.—ALFRED H. ALLEN.

A Phonoelectroscope.—A little instrument which I have recently contrived for the purpose of illustrating the heating power of the voltaic current, and which may be fitly called a *phonoelectroscope*, consists of a rectangular wooden box, ten inches by five, two steel or platinum wires stretched from end to end, a small spindle carrying two quill plectra, and an eccentric wheel for making and breaking the current through one of the wires. The wheel turns under a brass spring, which plays upon a button. The spring is connected with one electrode of the battery, the button with the wire nearest to it, and this wire with the other electrode. To exhibit the use of the instrument:—First, tighten the wires, by means of the milled-headed screws, to unison, to about the pitch of middle C.; then turn the spindle so as to sound the two notes in succession *before* the eccentric wheel makes the circuit. After these have sounded in unison, turn the spindle a little more; the circuit is made by wheel and spring, and presently the plectra play a second time on the wires, which now sound, with an interval of a tone or more, according to the quantity of electricity which has passed through one of them. By regulating the time between the instant when the wires sound in unison and the instant when they sound again, and noticing the musical interval caused by one of them becoming flat, we have an audible measure of the expansion of the connected wire, of the temperature to which it has been raised, and of the quantity of electricity which has traversed it to produce that effect. By continuing the movement, the interval between the notes will increase, and at last the wire operated on will become too slack to sound at all. If connection with the battery be now broken, and the heated wire be allowed to cool, its note will be heard to rise by degrees to its original pitch. With a single pair of plates, the phonoelectroscope answers well. The experiment is a striking one in a lecture-room, very instructive, and easily managed. The apparatus is so simple that anyone almost may make it for himself.—EDWIN SMITH, M.A.



NOTES AND QUERIES.

Atomic Weights.—In former numbers of the CHEMICAL NEWS extended quotations have been given from Professor Stas's minute and masterly researches on "Atomic weights," published in 1860, and it is interesting to notice how closely his results coincide with those deduced from the investigations by Dr. Penny on the same subject in 1839, as shown in the following comparative statement:—

	Stas.	*Penny.*
Chlorine	35·457	35·45
Nitrogen	14·044	14·02
Silver..	107·930	107·97
Potassium	39·137	39·08
Sodium	23·045	23·05

Camphor of Patchouli is quite white, not black, as stated in last number of CHEMICAL NEWS. I have a quantity in my laboratory which any one so interested may see.—SEPTIMUS PIESSE.

Substitute for Black Lead for Fire Grates.—Can any of your readers inform me where to find a description of a kind of paint, made with potassic or sodic silicate, intended to replace the use of plumbago for fire grates?—H. M.

New Colour Test for Blood.—From some experiments made by Professor Bloxam, of King's College, in a public lecture, it appears that a mixture of tincture of guaiacum and ozonised ether (that is to say, a solution of peroxide of hydrogen in ether) instantly produces, with blood or bloodstains, a beautiful blue tint. Professor Bloxam mentioned that he had extracted a single linen fibre, in the case of a blood stain twenty years old, and with an almost inappreciable amount of stain on it; and had found the characteristic blue colour was immediately induced by the test, and readily detected by microscopical examination.—*Lancet.*

New Freezing Mixture.—In the notice among "Notes and Queries" last week of a "New Freezing Mixture," there is an omission of the minus sign before the 8° Fahr., the temperature falling 8° below zero when from two to three ounces of material are used. I also find that the fluid obtained by mixing the powders mentioned in the note becomes solid in a day or two standing in a corked jar. The solid mass has the appearance of set plaster of Paris or damp chalk. The addition of a very little water appears to prevent this setting into a solid mass, but the chalky-looking citrate lies a long time in cold water without being dissolved. Further observations on the subject are necessary and may lead to interesting results.—JOHN GALLETLY.

Action of Leaves on Carbonic Acid.—In order to answer the often-doubted fact of the decomposition of carbonic acid and the formation of oxygen by the leaves of plants, Boussingault has introduced into mixtures of carbonic acid gas and hydrogen and the former gas and nitrogen first a clean stick of phosphorus; as long as no oxygen is present, this element does not undergo slow combustion, thereby giving off vapours, but as soon as a green leaf of any plant was carefully brought into the gaseous mixtures standing over mercury the slow combustion of the phosphorus began, owing to the decomposition of the carbonic acid and formation of oxygen; this action takes place also in diffuse daylight, but not during twilight; leaves wherein the chlorophyl is not fully developed do not act in this manner.

Test Paper for Detecting Minute Traces of Hydrocyanic Acid may be prepared, according to Schönbein, in the following manner:—Good filtering paper is thoroughly soaked in tincture of guaiacum wood containing at least from 3 to 4 per cent of resin. After drying, it is moistened with water containing in solution 0·25 per cent of sulphate of copper; this paper becomes coloured blue as soon as it is placed in contact even with very minute quantities of hydrocyanic acid. Test paper prepared with a solution of iodide of potassium and starch solution, will, when previously also moistened with the above-named solution of copper, become blue when placed into contact with small, otherwise not readily perceptible, quantities of hydrocyanic acid.—*Schweis. Wochensch. f. Pharm.*

Testing Glycerine for Sugar, Dextrin, Gum, and Glucose.—When glycerine, previously diluted with from 20 to 24 times its bulk of water, is mixed with a few drops of a solution of molybdate of ammonia, while also a few drops of nitric acid are added, the fluid, on being heated to boiling point, becomes coloured blue, when the glycerine has been adulterated with a solution of sugar; when dextrin is present, the reaction is not so marked, and the colour rather more greenish. But Dr. A. Vogel, who investigated this subject, states that the adulteration of glycerine by dextrin and glucose is infallibly detected by the well-known liquid, a solution of a salt of copper to which a solution of tartaric acid and caustic potassa are added, applied to the detection of grape sugar; as for gum, the molybdate of ammonia is a good test. The presence of gum in glycerine is indicated by a more pale blue colour.—*Industrie Zeitung.*

Testing the Decolourising Power of Animal Charcoal.—According to Tissandier, 10 grammes of a good specimen of this material carefully made, and also 10 grammes of the sample to be submitted to experiment, are taken and reduced to a very fine powder; each quantity is then placed on a paper filter of equal size, and next there is poured over the charcoal a quantity of 20 c.c. of a solution of rather dark brown sugar dissolved in water; the same quantity is repeatedly poured over the charcoal until the fluid which passes through the filter is of the same dark colour as the dark coloured sugar solution used. When, for instance, the liquid runs through the normal animal charcoal, as dark coloured as the originally applied solution, after eight doses of 20 grammes each, while such happens to occur with the charcoal to be tested after four of such doses, it is clear that the decolourative effect of the latter is only half that of the former.—*Moniteur Ind.*

Gas Purification.—Mr. Gasch, inspector of gas works at Neunkirchen, Prussia, has made a series of experiments with the view to settle a question which is also of scientific interest, viz., whether carbonic acid is expelled from its combination with lime (as formed in the purifiers of gas works) by sulphuretted hydrogen, or whether the reverse action takes place. The results obtained are the following:—*a.* Carbonic acid expels hydrosulphuric acid from its combination with lime. (The combination of hydrosulphuric acid with lime appears to be CaS,HS). *b.* Hydrosulphuric acid does not expel carbonic acid from carbonate of lime. *c.* When either illuminating gas, coal gas, or atmospheric air are passed through layers of sawdust, carbonic acid is expelled in large quantity, especially at the beginning of the operation, or when the temperature of the sawdust is artificially increased. *d.* Lime, which has been fully saturated with carbonic acid, absorbs hydrosulphuric acid very energetically as long as it is moist, while no gas is expelled from it.—*Journal fur Gasbeleuchtung.*

Dilatation of Petroleum by Heat.—M. Sainte-Claire Deville has recently called attention to a danger in respect of petroleum, paraffin oils, and the like fluids in consequence of the very great dilatation these liquids undergo by changes of temperature of the atmosphere no greater than those observed from winter cold to summer heat. Deville advises that casks and other closed vessels containing petroleum should never be filled, as the terms runs, full to the bung, for if this be done with the aforesaid liquids, there is an imminent danger of the vessels containing them being forced asunder by the mere dilatation of the liquid contained in them by an increase of temperature. It is, therefore, especially in cold weather, absolutely necessary to guard against entirely filling casks and other vessels entirely with petroleum and all similar fluids, since the bursting of the vessels may become attended with danger and risk of fire; explosion also may ensue by the vapour becoming mixed with air.—*Abridged from Moniteur Belge.*

Positive or Negative.—"A Medical Student" is suffering from a common form of confusion of ideas and terms. The galvanic current is set up at the surface of the zinc and is due to the force set free by the zinc while displacing hydrogen from the acid. Thus the zinc is the positive plate or element of the battery; the current passes through the liquid to the negative plate or element, the copper, platinum, or carbon, which merely collects the force and transmits it. As the current consists of polarised molecules there is a positive and negative at every point wherever the circuit is opened, and the side of the opening to which the current comes on its road from the zinc through the liquid is always the positive; therefore the wire leading from the negative element of the battery becomes its positive pole, and when

connected to another cell, it is the positive element of that cell; thus, if led to another battery cell, it is continued in the zinc or positive plate; if to a decomposition cell, it is the positive pole or anode, to which proceed the negative portions of the compounds under electrolysis, therefore called anions, which are the chlorous or acid elements and radicals. But they do not go to the anode from any "attraction" in themselves, or if free, they only range themselves in that order of polarity when forming parts of a molecule capable of being polarised and separated into two distinct components, therefore only binary compounds can be directly decomposed by the electric current. The terms zincode and platinode are merely confusing nuisances. The wire from the zinc plate is of course the negative pole of the battery; it is the road by which the electricity returns, to use a common phrase; really it is the completion of the circle of polarised molecules which is the essential character of a galvanic current, for only when that is provided is electricity developed; when chemical action takes place without this condition of a complete molecular chain, heat is developed by the action instead of electricity, in ratios which prove the two to be the same force under different conditions. Thus, in the cells, the current goes from zinc to copper; in the circuit its course is from copper to zinc.—John T. Sprague.

Positive or Negative.—Perhaps I might be allowed to answer "A Medical Student," who, in your impression of March 19, asks for information about the poles of the voltaic battery. In the first place he must remember that the positive element or plate is not the same as the positive pole, in fact, just the reverse, and this, I expect, is what has confused him. Now suppose we have a battery cell, the plates of which are zinc and copper, and the fluid the ordinary dilute sulphuric acid. The zinc is acted upon and oxidised by the acid, but the copper is not; the zinc therefore becomes positive, and the copper negative. A current of electricity would now pass from the Zn to to the Cu if it could, but as a current can only pass in a circuit and never in a straight line, the particles of the liquid are merely polarised and put in a state of tension; but if the plates are connected by a wire outside the cell, the circuit is completed, and the current can now pass from the zinc, through the liquid to the copper, thence back by the wire to the zinc. Now it must be noticed that the current inside the battery passes from *Zn* to Cu; but outside, or in the wire, from Cu to *Zn*. That pole from which the current starts is called positive; therefore, the zinc is the positive plate or element. But the copper wire is the positive pole, end, or terminal, or the anode; the copper plate is the negative plate, but the zinc wire is the negative pole or the cathode. Those substances which, on decomposition, appear at the positive pole or copper end are termed anions, viz., O, Cl, I, and the acids. Those which appear at the negative or zinc pole are cathions, viz., hydrogen, the metals, and combustible substances in general. Once more, the *Zn* is the positive plate, but negative pole; the Cu is the negative plate, but positive pole.—Sirius.

MEETINGS FOR THE WEEK.

Monday, 5th.—Royal Institution, 2. General Monthly Meeting.
—— Medical, 8.
Tuesday, 6th.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."
Wednesday, 7th.—Society of Arts, 8.
—— Pharmaceutical, 8.
Thursday, 8th.—Royal Institution, 3. Professor Tyndall, "On Light."
—— London Institution, 6.
—— Royal, 8.30.
—— Zoological, 8.30.
—— Royal Society Club, 6.
Friday, 9th.—Royal Institution, 8. Dr. Carpenter, "On the Temperature and Animal Life of the Deep Sea."
—— Astronomical, 8.
Saturday, 10th.—Royal Institution, 3. A. Geikie, Esq., "On the Origin of Land Surfaces."

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THE CHEMICAL NEWS.

Vol. XIX. No. 488.

CONTRIBUTIONS TO ANALYTICAL CHEMISTRY.*

By Dr. E. FLEISCHER, of Dresden.

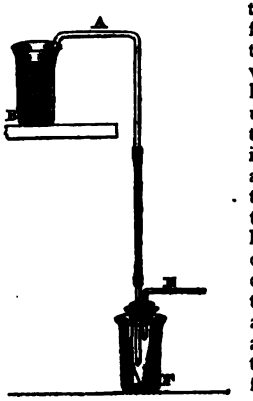
The Syphon Filter.

The operation of filtering gelatinous precipitates is well known to be one which consumes much time, especially when, as is frequently the case, it is desirable that the deposit should be thoroughly washed. Neither will decantation materially hasten the operation, because most gelatinous precipitates (especially alumina) settle only very slowly, and not always clearly, so that the supernatant liquid must still be filtered in most cases. Granular deposits also retard filtration to a considerable extent, as soon as the filter employed becomes only partially filled with them.

Lastly, the washing upon the filter of a not inconsiderable number of precipitates is always a very uncertain affair, because the washing water by no means always penetrates the entire mass, but much oftener finds out for itself certain channels which afford it an easier passage through the filter. All these drawbacks may, however, be remedied by using, instead of the ordinary filter, an instrument which filters and decants at the same time. A similar kind of filter, which I shall call the syphon filter, because it is founded on the principle of the syphon, has often been proposed for use in rapid filtration; nevertheless, among all these contrivances, we do not possess one of a suitable form for analytical purposes, although many may be used for manufacturing operations, especially on a proportionately large scale. I, on the contrary, have taken some trouble to render this principle of the syphon pressure applicable to quantitative estimation, and subjoin a description of my syphon filter as now manufactured according to my own plan by the well-known firm of Franz Hugershoff in Leipzic.

A is a double bent funnel; each bend is 1 decimetre long: the height of the receiver-shaped funnel is little more than 2 centimetres, the width 3 centimetres. This syphon is joined at its free end to an india-rubber tube united to a straight glass tube, so that the length of the entire shank of the syphon is made to approach 50 centimetres. The glass tube which is joined to the india-rubber pipe passes through a doubly perforated india-rubber stopper which fits into the pipe, C, which tapers to a point. The second hole in the stopper contains the suction pipe, E, which only just passes through and is bent at right angles.

In order to filter, there must first be spread over the mouth of the funnel a suitable round piece of muslin and upon that a similar piece of filtering paper; the muslin must be alike unaffected by acids or alkalies. Both filtering media must then be held by means of a tight india-rubber ring in the bell-shaped funnel; the filtering medium is sprinkled with distilled water and placed in the beaker, which serves to receive the substance to be filtered. It will be necessary in order that as little fluid as possible may be left behind in such filtrations, and that no unnecessary quantity of water be used in washing, that certain dimensions which have proved to be the best should be adhered to in this vessel; success will then be certain. It will conveniently contain 100 c.c., and the quantities of liquid which are left from such filtrations and which contain the deposit amount to scarcely more than 5 c.c. Even when B contains no deposit there does not remain more than 7 c.c. at most after filtering the clear liquid; but since the vessel is filled each time with at least 100 c.c. of the liquid, the residue will amount to 1-20th of the fluid used, so that a deposit, after threefold washing contains only 1-150,000th of the substance which was disseminated and contained in the original mass. It will be seen by this that in most analyses one washing instead of three will give a sufficiently pure residue; the washing water may also be more completely utilised than by employing the ordinary funnel filter, because it can be better agitated with the deposit. Lastly, the filtering surface always remains pure, because the filtration takes place from beneath to above, and in consequence of this and of the considerable pressure of 50 c.c. of liquid, the filtration takes place in about one-fifth of the time required when using the ordinary filter instead; since there is an average discharge of 20 c.c. of liquid per minute. The process of filtering is as follows:—B must be placed upon the table at such a height as to be convenient for stirring and filling; the vessel, F, which receives the filtrate stands lower. As soon as B is filled the suction pipe, E, must be exhausted, and at the same time the opening, O, must be closed with the fore-finger; when the liquid has arrived in the india-rubber pipe, F is placed under it and the filtration continues as long as the filtering medium is covered with liquid. When this is no longer the case, B is again filled with the liquid or substance to be filtered, and the whole well agitated by repeatedly raising and lowering the funnel. One filtration being finished, the funnel is washed, together with the paper over B, which in order to preserve the last drops of the liquid, is held up and pricked. If it be desired to ignite and weigh the residue, it must be washed out of B into a small platinum dish, which is then placed over a water bath to evaporate all moisture, and heated either in the dish itself or in a porcelain or platinum crucible. The desiccation in the drying room may be omitted and also the burning of the filter, as they would take up too much time. Should it be necessary for a deposit to be again dissolved, one great convenience of this contrivance is, that at the end of the filtration it will be found ready in the beaker with a minimum quantity of water, thereby removing the inconvenient rinsing out of the filter, a part of the process which in the case of strongly adhering deposits requires large quantities of water.



These are the essential advantages of the syphon filter I always employ it if the fluid to be filtered amounts to more than 100 c.c., or if a voluminous deposit is to be washed.

* Communicated by the Author.

SPECTROSCOPIC OBSERVATIONS OF THE SUN

By J. NORMAN LOCKYER.*

No. III.

In a former paper† the author stated that Dr. Frankland and himself had searched without success for the known third line of hydrogen in the spectrum of the chromosphere. He has now discovered that the position of the third line is at 2796 of Kirchhoff's scale. The author assumes that the darkening of the limb is due to the general absorption of the chromosphere, and therefore it follows:—

1. That the additional selective absorption near the limb is extremely probable.

2. That the hydrogen Fraunhofer lines indicating the absorption of the outer shell of the chromosphere will vary somewhat in thickness: this he found to be the case to a certain extent.

* Abstract of a paper presented to the Royal Society, March 4th, 1869

† Chemical News vol. xix, p. 158.

3. That it is not probable that the prominences will be visible on the sun's disc.

On the 20th of February a spot was observed in which the *general* absorption was so great that the several lines could only be distinguished with difficulty, except in the very brightest region, which is ascribed to the greater length of the absorbing medium in the spot itself in the line of sight when the spot is observed near the limit instead of the centre of the disc.

Mr. Lockyer has succeeded in adding magnesium and barium to the material (sodium) to which he referred in paper No. 1 (published in 1866). He no longer regards a spot simply as a cavity, but as a place in which principally the vapours of sodium, barium, and magnesium occupy a lower position than they do ordinarily in the photosphere. It therefore follows—

1. The lines of sodium, magnesium, and barium, when observed in a spot, are thicker than their usual Fraunhofer lines.

2. The lines of sodium, magnesium, and barium, when observed in the chromosphere, are thinner than their usual Fraunhofer lines.

These facts give additional evidence that a spot is the seat of a downrush—a downrush to a region, as we now know, where the selective absorption of the upper strata is different from what it would be, and indeed is elsewhere at a higher level.

The author thinks there are two causes for the darkening of a spot, viz. :—

1. The general absorption of the chromosphere thicker here than elsewhere, as the spot is a cavity.

2. The greater selective absorption of the lower sodium, barium, magnesium stratum, as the surface of its last layer is below the ordinary level.

Mr. Lockyer is waiting to make observations with the large Stenheil spectroscope to finally test the accuracy of the valuable suggestion of Messrs. De La Rue, Stewart, and Loewy in their "Researches on Solar Physics," that if the photosphere of the sun be the plane of condensation of gaseous matter, the plane may be found to be subject to periodical elevations and depressions, and that at the epoch of minimum sun-spot frequency the plane might be uplifted very high in the solar atmosphere, so that there is comparatively little cold-absorbing atmosphere above it, and therefore great difficulty in forming a spot.

With a rapidly oscillating slit the author was not satisfied with his results, but on hearing that Mr. Huggins had succeeded in seeing the form of the solar protuberances by using absorbing media and a wide slit, he was led to try the wide slit without the absorptive media, and in the following words he describes the results:—"The solar and atmospheric spectra being hidden, and the wide image of the slit alone being visible, the telescope or slit is moved slowly, and the strange shadow-forms flit past. Here one is reminded by the fleecy, infinitely delicate cloud-films of an English hedge-row with luxuriant elms; here of a densely intertwined tropical forest, the intimately interwoven branches threading in all directions, the prominences generally expanding as they mount upwards, and changing slowly, almost, indeed, inperceptibly. By this method the smallest details of the prominences and of the chromosphere itself are rendered perfectly visible and easy of observation."

In an addendum dated March 17th, the author states that more favourable weather had enabled him to continue his researches in reference to his method for viewing the prominences, and to view the injection of sodium, magnesium, &c., into the chromosphere. He thinks that in time it will be possible to see the prominences as they really are seen in an eclipse by constructing a rapidly revolving wheel with red, green, and violet glass of the required absorptions, in which the percentages of light of each colour may be regulated. On the 14th of March, with a tangential slit, a fine dense prominence near the sun's equator on the eastern limb was observed.

ON THE

EXAMINATION OF THE "FLAME" OF THE BESSEMER CONVERTER.*

By THOMAS ROWAN.

THE Bessemer process for the manufacture of steel is now among the most important of our metallurgical operations. On account of its comparatively recent introduction among established industries, it affords an ample field for scientific investigation, and there is no feature of the process at once so interesting and important as that of the flame which issues from the "converting vessel."

The success of a "blow" undoubtedly depends on the accuracy and completeness of many details, but of them all, the most important is to know and catch that moment in the existence of the flame when the carbon in the iron has yielded its last trace to the oxygen of the air.

If a charge is "over-blown"—that is, if it be subjected to the action of the air for too long a period, or if it be "under-blown"—that is, if the admission of air is stopped before the proper chemical action has been completed, the steel will be found to be defective in proportion to its unskilful treatment.

The flame issuing from the converter is the index of these changes which the molten mass of metal is undergoing during the process; but the exact moment of decarburisation is often, from a variety of causes, difficult to determine.

It is for these reasons that the examination of the flame forms the point of attraction of the process; and I have thought it might not be uninteresting to the members of this Society to describe to them the general appearance which this flame presents to the eye, and some experiments which my brother has made with the spectroscope and with coloured glasses, for the purpose of more readily determining that critical period or "change" in the flame which I have spoken of. The success of these latter experiments has enabled him to obtain the object for which they were commenced; and he has designed an instrument, which I shall describe hereafter, by which the change in the flame is more easily determined.

1st. The General Appearances of the Flame to the Eye.

When the vessel is first turned up, a shower of brilliant sparks is ejected, owing to the force of the blast reaching first a thin layer of metal as the vessel slowly swings round to the vertical position.

From 0 to 3 or 4 minutes.—When the full head of metal is over the blast, at first, for three or four minutes, there is scarcely any flame, only a current of very hot gases and very numerous sparks.

From 3 or 4 to 5 or 6 minutes.—Gradually a small pointed flame appears in the centre of the sparks, and this quickly increases in size, without gaining much brilliancy for two or three minutes.

From 5 or 6 to 9 or 10 minutes.—During the next period of four or five minutes the flame is very unsteady, both in size and in position, and its oscillations are accompanied by hollow sounds, as of reports or explosions in the interior of the converter.

From 9 or 10 to 11 or 12 minutes.—Streaks, or flashes of brighter flame now shoot up through this comparatively non-luminous flame, and, within one or two minutes, give place to a continuous stream of dense and brilliant fire, which rushes far up the chimney and illuminates the entire building, often casting the shadows of the cranes, &c., against the windows through which the sun is shining.

From 11 or 12 to 15 or 16 minutes.—This flame gradually becomes thinner and more transparent, without losing any of its brilliancy during the six or seven minutes of the blow which generally remain, until it suddenly

* Read at the meeting of the Chemical Section of the Glasgow Philosophical Society, March 29, 1869.

(preceded, however, by a few hollow and peculiar sounds from the interior of the vessel) loses its brilliancy and much of its size, and drops down, within about half a minute, to about the size it had reached at about five minutes of the blow; this flame however, being more dense and more luminous than the flame at that earlier period.

Any of the stages described may, from a variety of causes, be prolonged; or an insufficiency of blast, however caused, may lengthen the entire period of the blow for several minutes, but the above is a fair average blow with the best English hæmatite pig-iron. If inferior irons are used, the flame at the change is more or less enveloped in a dense white smoke, and the change is accompanied by violent pulsations, or "coughings," of the entire flame, which, under these circumstances, has often a yellowish red colour to the eye; all this making the change, often very difficult, if not impossible, to detect. Nervousness or biliousness, by variously affecting the sight of the observer, may also render him unable with certainty to determine the precise moment when he ought to "turn down"; and there is a marked difference in the facility of observation noticeable between a blow taking place in daylight and one at night.

2nd. The Appearance of the Flame as Examined by means of the Spectroscope.

It was important, first, to note if any of the lines belonging to the Bessemer flame were to be found in the flame given off from the coke fire used to heat up the converter. Several examinations were made; the result of these was that, besides the invariable yellow bright line, the red line, and the two bright green lines next the yellow, were occasionally to be seen. Owing, however, to the want of brilliancy of this flame, the spectrum which it gave was very faint, and, at times, almost invisible.

On first turning up the vessel, and for about four minutes thereafter, the spectroscope showed only a continuous band of light, with the colours rather hazy, and so much blended with one another as to make it impossible to mark the junctions of the different fields.

In from four to six minutes, flashes of the yellow line became visible (corresponding to the appearance of tongues of a bright flame, shooting up in the centre of the dull red one issuing from the mouth of the converter); and in one or two minutes after its first appearance, this line became quite steady, and did not disappear even at the end of the blow. Simultaneous with the steadying of the yellow line, the red, yellow, and green fields became clear and well-defined bands of bright colour.

In half a minute to a minute later, a bright green line appeared near the yellow, following which, in scarcely ever more than half a minute, a red line appeared, equidistant from the yellow (of course on the opposite side). These two generally became steady together (having first appeared in intermittent flashes) in about half a minute after both were visible. With the steadying of these two lines at once, a second green line (bright, and about the centre of the green field) became visible, wavering a little at first. About a quarter of a minute served generally to steady it, although sometimes it was a minute and a half from the appearance of the first green line till the second green line with the red became steady.

In one or two minutes, a third green line, nearer the blue field, came into view, and in about one minute was steady. When the red appeared with the first green line, the second and third green lines generally appeared together; but when the red appeared with the second green line, the third green was accompanied by a blue bright line near the green field. In about ten minutes after turning up the converter, the flame attained its maximum size and intensity of light, when a second and third bright line became visible in the blue field. Very often these were only intermittent and very faint; but with "hot metal," and a bright flame, they were pretty steady and distinct, and were broader than those in the yellow, green, and red fields.

Occasionally, for about two or three minutes before the close of the blow, a bright line was seen in the purple field, pretty far to the right of the spectrum; sometimes this only flashed brightly, but on a few occasions it was clearly seen, though faint.

With a very bright flame, several dark lines were seen, but, for want of definiteness, it was impossible to say whether they were not due to the contrast afforded by the brilliancy of the bright ones beside which they appeared. A narrow dark line was seen on each side of the red line, and a broad dark band dividing the yellow from the green; then one between each green line, and two in the blue field, between the three blue lines. But these were only seen with an exceptionally bright flame, and, therefore, are not of much importance.

All the bright lines visible remained steady for several minutes before the close of the blow, affording an excellent opprtunity for their examination; but, at the last, all (with the exception of the yellow) faded in less than thirty seconds. The purple line disappeared first (whenever it happened to be visible), then the three blue lines, in the inverted order of their appearance, then the third green, after which the second, then the red, and last of all the first green, when the blast was shut off.

The green and the red lines, from their distinctness, afforded the best point for a determination of the process; and these were so constant, that a sure indication could always be given by any of them, if it were made the index by which to determine the period of blowing.

Very often, on adding the charge of spiegeleisen, a large and very brilliant flame rushed out of the converter for some minutes, and on examining it, the red, yellow, three green, and a very brilliant purple line were seen, but no blue.

3rd. Some Experiments with Coloured Glasses on the Flame.

I shall now proceed to describe some experiments made with coloured glasses on the Bessemer flame. I may mention that what led to them was my brother being compelled to get very dark spectacles to protect his eyes, which were not very strong, from the intensity of the light of the flame. The first pair made completely overcame the brilliancy of the flame, without imparting any colour to it; but, on ordering a second pair, they showed so much colour as to render them useless. On appealing to the workman who had made them, he found that no note had been kept of the kinds of glasses which had been used in the first pair; and, although several attempts were made to repeat them, the second pair sent was the best he could accomplish, and they had appeared colourless to sunlight. The thought then occurred, that, as the brilliancy of the flame varies considerably during its existence, a variation in the amount of transmitted light might be found to affect, in proportionate degree, the power of some coloured glasses to absorb other colours in combination with them, and that a combination of colours might be found to give, with a small quantity of transmitted light, a distinct colour, which could be quite absorbed when a larger quantity of light was passed through the same glasses.

Another, and perhaps the most important, consideration which led to the following experiments, was that the flame itself has a varying chemical composition as the silicon, manganese, carbon, and iron become successively attacked, and that the temperature of the flame at these various stages must necessarily be altered, giving rise, of course, to various colours, or shades of colour, in the flame. If, therefore, a combination of coloured glasses could be found which would absorb the colour due to the flame at a particular temperature, it seemed clear that a change of temperature would become immediately visible, on account of an accession or diminution of colour to the flame as thus observed. It is probable, too, that the colour possessed by the flame at its different stages is due to the various elements which are at these periods

being volatilised, but the spectroscope does not throw much light on this supposition.

The first combination of coloured glasses which I have noted are a

Ruby and Emerald.	It was found that these colours mutually destroyed each other. The Bessemer flame, when viewed through them, appeared white, and without brilliancy.
Ultramarine blue, Dark yellow.	This combination gave the same effect as above.

With a combination consisting of—

Ultramarine blue, Dark yellow, Ultramarine blue, Emerald.	The flame appeared of an emerald colour, but was dark and without brilliancy.

In the next experiments, the dark yellow and one blue were replaced by a light yellow and neutral tint, thus:—

Ultramarine blue, Light yellow, Neutral-tint, Emerald.	The appearance of the flame in this case was similar in colour to that afforded by the above combination, but appeared of considerable brightness.

In the next experiments, the light yellow and neutral tint were replaced by a dark yellow and red, respectively, thus:—

Ultramarine blue, Dark yellow, Ruby, Emerald.	The flame at first was dimly seen, and without colour; when it reached its maximum brilliancy, it still appeared white through this combination.

With these five combinations, the appearance of the sun, as seen through each of them, was similar in character to that of the flame, but more powerful in degree.

In the subsequent experiments, the combination was as follows:—

Ultramarine blue, Dark yellow, Neutral tint, Ultramarine blue.	The flame appeared at first of a ruby-red colour, increasing in size and intensity as the blow progressed, the edges of the flame acquiring a lighter shade of red, but the colour was too strong to admit of the changes being easily determined. Sunlight, through this combination, was slightly yellow.

In the succeeding experiments, one of the blue glasses was replaced by a light yellow, giving a combination of—

Ultramarine blue, Dark yellow, Neutral tint, Light yellow.	The flame appeared at first of a yellowish red colour; as the blow progressed this colour became whiter, with flashes of redder flame occasionally through it. At the flame's maximum brilliancy, the edges assumed a light-red colour (nearly white), while at the root and centre of the flame the colour was of a darker yellowish red. When the flame dropped (at the end of the blow), it returned to a yellowish red colour, somewhat similar in appearance to the effect produced at the beginning of the blow. Sunlight appeared slightly yellow.

It will be observed that this combination gave nearly the desired effect—viz., a variation of depth of colour due to the differences of temperature or brilliancy of the flame at its different stages of progression. The yellowish tint, however, always present, showed a defect in this combination, to overcome which further trials were made. Among other devices, the light yellow was omitted, and the flame was observed with—

Ultramarine blue, Dark yellow, Neutral tint.	The flame appeared still red, and with the yellowish tint, though in such small degree as to show that the desired result was not far off. Sunlight appeared dim, and slightly yellow.

In the concluding experiments, the neutral tint was replaced by a blue glass, with the object of ascertaining whether the yellow colour could be corrected by the omission of the red or the blue component of the neutral tint, thus:—

Ultramarine blue, Dark yellow, Ultramarine blue,	This combination was perfectly successful, the lingering trace of yellow being removed.

I shall now describe more fully the appearance of the flame through it.

For the first four or five minutes all is dark; the chimney is invisible; nothing but the mouth of the converter can be made out, which appears slightly red, the sparks coming from it being scarcely visible. As the blow progresses, the flame, still red in colour, increases in size and luminosity, while the outline of the vessel becomes visible. In about twelve to fifteen minutes the flame begins to lose its colour, becoming violently agitated, flashes of a lighter and brighter flame shooting up occasionally.

In about fifteen minutes a purple tint becomes visible round the mouth of the vessel, the flame gradually acquiring a white colour towards the edges.

When the flame has reached its maximum brilliancy it appears bright and nearly white, with the edges purple. The red colour thereafter begins to re-appear at the mouth of the vessel and centre of white flame, gradually extending until the whole flame appears of a light red colour.

And with the peculiar hollow sound heard in the vessel always preceding the drop, the centre of the flame begins to acquire a deeper colour; this quickly extends and deepens. Within a minute or so of the drop the whole flame becomes crimson, and losing its brilliancy, and within half a minute, it suddenly goes back to very nearly the red colour it had at starting.

This combination of glasses is now in daily use in the Atlas Works, its indications being so marked and unmistakable as to render its use safe in the most inexperienced hands. This little instrument or "Chromopurometer," as it is proposed to call it, is arranged as follows:—

One of the blue glasses and the dark yellow one are fixed in a rectangular frame, carrying at its foot a hinge to which the thin frame holding the other blue glass is attached, and at its top a spring catch to hold this smaller frame when in its shut position, and also a pin and set screw for attaching the whole instrument to the hat of the observer so as to place it before his eyes.

The object of having the glasses thus divided is to give facility for the observation of the flame through the combination of three, while during the pouring two being sufficient, the third one is allowed to hang down, when it serves to protect the lips from the great heat of the ladle and liquid steel.

In conclusion, I think it is probable that, by carefully noting by means of coloured glasses such as that described, the amount of light (as determined by the shade of *colour* visible) emitted by flames of known temperature, a scale might be formed which would enable us approximately to measure the temperature not only of the flame of the Bessemer Converter, but also that of many flames which have hitherto been considered beyond reach of our ordinary methods of measurement.

Toluol.—(*Comptes Rendus*, 1869, No. 10).—M. A. Rosenstiehl has made a series of experiments with the view to solve the question whether the toluol we are acquainted with is a mixture of two isomeric hydrocarbons, which would yield two toluidines, or whether toluol is a peculiar principle which on being acted upon by nitric acid is converted into two different nitro-compounds. From seven samples of toluol prepared by as many different processes, the author has obtained the same result, to wit, a crystallised nitro-toluol, corresponding to toluidine, and another liquid—nitro-toluol—corresponding to the pseudo toluidine. By the reduction of divers nitro-toluols, prepared by various methods, the author obtained a large quantity of alkaloids which have been submitted to analysis; he found also (1) there are always two nitro-toluols formed, which, by reduction, yield two toluidines; (2) the proportion of the two nitro substances is not constantly the same; he never obtained more than 66 per cent and never less than 33 per cent of toluidine from 100 parts of crystallised nitro-toluol.

ON THE WASHING OF PRECIPITATES.*

By Professor R. BUNSEN.

(Continued from p. 162).

In washing, by means of decantation, in the ordinary manner, the amounts of chromium sesquioxide found were as follows :—

grms.

II. 0·2458, after 5 decantations, washed to the 50,000th part.

III. 0·2452, after 7 decantations, washed to the 200,000th part.

IV. 0·2443, after 10 decantations, washed to the 100,000,000th part.

0·2451 mean.

By the use of the pump :—

grms.

V. 0·2435, after 5 additions of water.

VI. 0·2434, „ 4 „ „

VII. 0·2432, „ 3 „ „

VIII. 0·2435, „ 2 „ „

IX. 0·2439, „ 1 addition of water.

X. 0·2439, „ 1 „ „

0·2436 mean.

Hence the probable amount of chromium sesquioxide contained in the solution, according to the experiments with the pump, was 0·2436 grm.; according to the old method of decantation it was somewhat higher, namely 0·2451 grm. This excess of 1·5 milligramme shows that the adhesion of the soluble matters to the precipitate and to the filter is, in consequence of the greater pressure, more easily overcome in the new method than in the customary process; it follows, therefore, that we can obtain a more complete washing by the new method than by the old. The old process of decantation required 108 minutes and 1050 c.c. of water to effect a washing to the 50,000th part; the new, on the contrary, only 12 to 14 minutes, and not more than 39 to 41 c.c. of wash-water. If a precipitate be heated in a platinum crucible immediately after filtration by the older process, a portion will inevitably be projected out of the crucible. Hitherto, therefore, it has been necessary to dry the filter and precipitate before ignition. Now to dry a quantity of hydrated chromium sesquioxide containing 0·2436 grm. Cr_2O_3 in a water-bath at 100° C. requires at least 5 hours; and, moreover, bringing the dried precipitate into the crucible, burning the filter, and gradually igniting the mass is in the highest degree tedious and troublesome. All this expenditure of time and labour may be saved by employing the new method. By its means a precipitate is as completely dried upon the filter in from 1 to 5 minutes as if it had been exposed from 5 to 8 hours in a drying-chamber; and it can immediately, filter and all, be thrown into a platinum or porcelain crucible and ignited without the slightest fear of its spurting. By operating in the following manner the filter burns quietly without flame or smoke; this phenomenon, although remarkable, easily admits of an explanation. The portion of filter-paper free from precipitate is tightly wrapped round the remainder of the filter in such a manner that the precipitate is enveloped in from four to six folds of clean paper. The whole is then dropped into the platinum or porcelain crucible lying obliquely upon a triangle over the lamp, and pushed down against its sides with the finger. The cover is then supported against the mouth of the crucible in the ordinary way, and the ignition commenced by heating the portion of the crucible in contact with the cover. When the flame has the proper size and position, the filter carbonises quietly without any appearance of flame or considerable amount of smoke. When the carbonisation proceeds too slowly, the flame is moved a little towards the bottom of the crucible. After some time the precipitate appears to be surrounded only by an extremely thin envelope of carbon, possessing exactly the form (of course diminished in size) of the original filter; the flame is then increased, and the crucible maintained at a bright-red heat until the carbon contained in this envelope is consumed. The combustion proceeds so quietly that the resulting ash surrounding the precipitate possesses, even to the smallest fold, the exact form of the original filter. If the ash shows here and there a dark colour, it is simply necessary to heat the crucible over the blowpipe for a few minutes to effect the complete removal of the trace of carbon. This method of burning a filter is extremely convenient and accurate; it is only necessary to give a little attention at first to the slow carbonisation of the paper, after which the further progress of the operation may be left to itself.

Gelatinous, finely divided, granular, and crystalline precipitates, such as alumina, calcium oxalate, barium sulphate, silica, magnesium ammonium phosphate, &c., may with equal facility be treated in this manner; so that even in this particular the work, in comparison with the method generally adopted, is considerably shortened and simplified.

From the above experiments it appears that the time necessary to filter and dry a quantity of chromium sesquioxide, hitherto requiring about 7 hours, is reduced by the new method to 13 minutes. This saving of time is, moreover, proportionately greater in the case of precipitates more easily filtered than hydrated chromium sesquioxide. Particularly is this so in separating a finely suspended precipitate from a large volume of water. Under these circumstances the clear fluid runs through the filter in a continuous stream, so rapidly that it is scarcely possible to maintain the supply; the entire operation, in fact, requires scarcely more time than that necessary to pour a liquid from one vessel to another. Filtration, therefore, may be effected as quickly through the smallest as through the largest filter. Moreover, the exceedingly small amount of water required to wash a precipitate completely renders unnecessary the tedious evaporations which, by the older method, are almost inevitable when the filtrate is needed for a further separation. Thus the introduction of impurities from the action of the liquid upon the dish in the course of evaporation is prevented; and also the loss due to the slight solubility of the greater number of precipitates in the wash-water is reduced to a minimum. Supposing we had to analyse an alkaline chromate in which the quantity of chromic acid is equivalent to 0·2436 grm. chromic sesquioxide, as in the above-described experiments, then to determine the proportion of akali we should, by using the older method, require the preliminary evaporation of about 1050 c.c. of liquid; by the new method the evaporation of 40 c.c. only is necessary. Now by employing the best form of water-bath, *i. e.* one possessing a constant water-level, such as is used in my laboratory, it is possible, under favourable circumstances, to evaporate in a porcelain dish 1 c.c. of water in 27 seconds. Consequently the evaporation of the filtrate obtained by the older method would occupy about 8 hours, whilst by the new 18 minutes only are required. The total length of time needed to filter the chromium sesquioxide, wash and dry the precipitate, and evaporate the filtrate is reduced, therefore, from 14 or 15 hours to about 32 minutes.

The experience I have subsequently gained in my laboratory, where the method has been in general use for the last nine months, fully confirms the above results. It has shown that, on the average, three or four analyses can now be made in the time formerly demanded by a single one.

Another and an inestimable advantage springs from the

* We are kindly permitted by the proprietors of the *Philosophical Magazine* to copy these portions of Professor Bunsen's paper from their number for January, 1869, where the complete paper may be found.

peculiar condition of a precipitate filtered by this method. It not unfrequently happens, even in the hands of experienced manipulators, in consequence of the agitation it is necessary to give to the contents of the filter to effect their complete washing, that the surface of the filter becomes injured and torn, so that the precipitate becomes mixed with filaments of paper; this is particularly the case in using hot water. Supposing the precipitate to consist of mixed hydrates of the sesquioxides (for example, iron and alumina), it will be found, on redissolving in an acid, that the filaments, like tartaric acid, prevent the complete separation of these substances by subsequent precipitation; thus the alumina will contain iron, and on precipitation by means of ammonium sulphide will be coloured black. On the other hand, by employing the new method the precipitate coheres so firmly that the introduction of this source of error is impossible, even by using common grey filter-paper. The most

Fig.2.

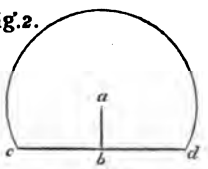


Fig.4.

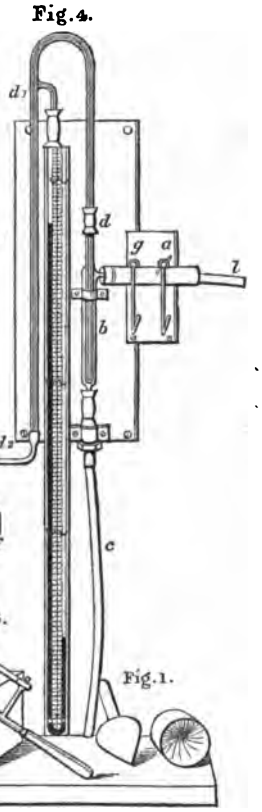


Fig.5.

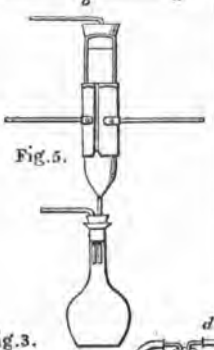


Fig.3.

Fig.6.

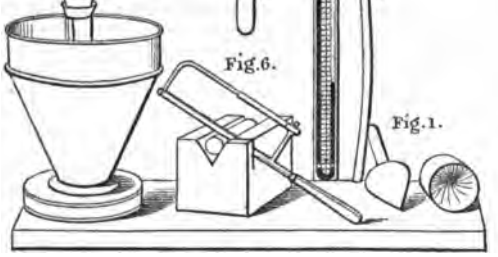


Fig.1.

gelatinous precipitates, as hydrated ferric oxide, alumina, &c., adhere to the filter in a thin coherent layer, and may be removed, piece after piece, so completely that the paper remains perfectly clean and white. The advantage thus gained, where it is necessary to transfer mixed precipitates to another vessel in order to effect their subsequent separation, is evident.

The filter-pump, moreover, is exceedingly serviceable in separating precipitates or crystals from syrupy mother-liquors. Thus honey-sugar may be so completely separated from the thick viscid liquid in which it forms, by a filter of coarse grey paper, that it remains only slightly coloured, and by a single crystallisation from alcohol may be obtained in small white shining needles. And since the bulk of the moist precipitates, particularly that of the more gelatinous, is so much diminished under the high pressure, the precipitate only occupying one-third to one-sixth of its bulk under ordinary circumstances, a filter of one-third to one-sixth of the size usually employed may be taken, and thus the amount of ash proportionately lessened.

As the water air-pump suffers no injury from the presence of corrosive vapours or gases, we can equally well employ it to filter liquids containing nitrous acid, sulphurous acid, fuming nitric acid, chlorine, bromine, volatile chlorides, &c. In such cases I use a peculiar filtering arrangement, consisting of a cylindrical glass vessel, the lower end of which is drawn out before the blowpipe to the form shown in fig. 5; in this drawn-out portion a thin plate, 1 or 2 m.m. in thickness, of artificial pumice, such as is used by polishers, is packed water-tight by means of asbestos. This apparatus is arranged for the purpose required exactly as the funnel in the method of filtration by pressure above described. In order to have a number of these filters in readiness, a pumice-stone cylinder of the required diameter is turned in a lathe, and then the thin plates sawn off by means of a small hand-saw in the small wooden support shown in fig. 6. The upper surfaces of the plates may afterwards be rendered perfectly even by a coarse file.

By the aid of these pumice-stone filters many chemical products may be made, the preparation of which has hitherto been almost impossible. For the sake of example, I take the preparation of pure dry chromic anhydride; in an hour it is easily possible to filter, wash, and dry crystals of this substance an inch in length. A solution of 2 parts of potassium dichromate in 20 parts of water mixed with 10 parts of concentrated sulphuric acid, deposits, after standing about 24 hours, numerous brilliant needles of chromic anhydride. These may be drained from adhering mother-liquor upon the pumice filter by means of the pump, and in a few minutes completely washed by a small quantity of fuming nitric acid free from nitrous acid. A covering of tolerably strong sheet copper provided with two arms, as shown in fig. 5, is then placed round the tube; by hanging lamps upon the arms the tube may be readily heated to about 60° or 80° C.; and by connecting a chloride-of-calcium tube with the upper end of the glass vessel, a current of dry air may be drawn through the apparatus by means of the pump, and thus, in a comparatively short time, large and brilliant crystals of chromic anhydride, perfectly dry and free from all impurity, may be easily obtained.

A single pump of the above description costs, including the leaden piping, about 8 thalers (24 shillings); and experience has shown that five or six are amply sufficient for a laboratory of fifty or sixty students. The apparatus, as may readily be seen, can be applied in the operation of evaporating *in vacuo*.

I believe that the above-described water air-pump will soon become an indispensable piece of apparatus in chemical laboratories. It not only serves as the most convenient method of producing the differences in pressure required to accelerate the process of filtration, and of obtaining the necessary vacuum for evaporation; it is equally adapted for purposes to which neither the mercury nor the ordinary pumps are in any way applicable. By its aid it is possible to calibrate a thermometer with the greatest accuracy, and to estimate the vapour-tension of such corrosive bodies as bromine, chromyl dichloride, &c. by the simplest method possible, in which the necessary operations require scarcely more time than an ordinary determination of a boiling-point.

I purpose returning to these applications of the instrument in a future communication.

Artificial Sulphate of Baryta.—(*Boston Journal of Chemistry.*)—This, applied to glass by means of silicate of potash, imparts to it a milk-white colour of great beauty; in a few days the silica is intimately combined with it, and the colour resists washing with warm water. By the action of strong heat, this siliceous varnish is transformed into a white enamel. Blue ultramarine, oxide of chromium, and pulverised coloured enamels may be likewise applied.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, Tuesday, March 30th, 1869.

Dr. WARREN DE LA RUE, F.R.S., President, in the Chair.

THE business of the evening commenced with the reading of the financial statement by the Treasurer, which had been audited by Mr. Tuson and Mr. Robert Warington.

The PRESIDENT called the attention of the Society to a circular from Yale College, warning the scientific public against an impostor who was ostensibly collecting minerals and was receiving monies in the name of some of the principals of the college. He then proceeded to read the address, which gave a very clear account of the year's progress in chemistry, and referred to some of the leading investigations in the various departments of chemical science.

Mr. HEISCH, in proposing a vote of thanks to the President for his address, spoke in laudatory terms of the way in which Dr. De La Rue had filled the Presidential chair, and proposed that the address be printed, and circulated amongst the fellows of the society.

Professor WANKLYN seconded the vote of thanks, and spoke of the great difficulties with which the President had had to deal at different times during his presidency.

Dr. ODLING could not recall a president who had devoted so much time and attention to his duties as Dr. De La Rue. He had also achieved some difficult negotiations with a success which showed, in the highest degree, the esteem in which he was held, and the position which the Society had attained.

The proposal was carried by acclamation.

The meeting then proceeded to the election of officers, Messrs. Basset and Warington acting as scrutators. The following are the names of the officers for the present year :—

President.—A. W. Williamson, Ph.D., F.R.S.

Vice-Presidents, who have filled the office of President.—Sir B. C. Brodie, F.R.S.; Warren De La Rue, Ph.D., F.R.S.; Thomas Graham, D.C.L., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; W. A. Miller, M.D., D.C.L., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S.; Colonel P. Yorke, F.R.S.

Vice-Presidents.—J. H. Gilbert, Ph.D., F.R.S.; J. H. Gladstone, Ph.D., F.R.S.; H. M. Noad, Ph.D., F.R.S.; W. Odling, M.B., F.R.S.; T. Redwood, Ph.D.; John Stenhouse, LL.D., F.R.S.

Secretaries.—A. Vernon Harcourt, M.A., F.R.S.; W. H. Perkin, F.R.S.

Foreign Secretary.—H. Müller, Ph.D., F.R.S.

Treasurer.—F. A. Abel, F.R.S.

Other Members of Council.—E. Atkinson, Ph.D.; J. Lothian Bell; E. T. Chapman; W. Crookes, F.R.S.; David Forbes, F.R.S.; D. Hanbury, F.R.S.; A. Matthiessen, Ph.D., F.R.S.; E. J. Mills; J. Prestwich, F.R.S.; Maxwell Simpson, Ph.D., F.R.S.; A. Voelcker, Ph.D.; C. Greville Williams, F.R.S.

Mr. FIELD proposed a vote of thanks to the officers and council for their efficient services during the past year, and associated with the vote the names of Dr. Redwood and Dr. Odling. For twelve years Dr. Odling had, with hardly a single exception, occupied the Secretary's chair at every meeting of the Society; and they could not allow him to conclude his secretaryship without thanking him for his kindness and courtesy, as well as for his successful endeavours to promote the welfare of the Society.

Mr. TUSON, in seconding the vote, also spoke in appropriate terms of the valuable services of Dr. Odling and Dr. Redwood.

The PRESIDENT said that the Secretary was the most active agent of the Society. Without active secretaries, the meetings would sometimes pass over without that intellectual food from which they derived so much benefit.

The vote was carried amidst great applause.

Dr. ODLING thanked the Society for the kind manner in which they had expressed their satisfaction with the services of himself and Dr. Redwood, and referred to some of the changes which had taken place in connection with the Society during the thirteen years he had been Secretary, and also to the pleasure he had derived from being on terms of close acquaintance with the distinguished men who had filled the chair during his term of office.

A vote of thanks to the Scrutators brought the proceedings to a close.

Thursday, April 1st, 1869.

Dr. A. W. WILLIAMSON, F.R.S., President, in the Chair

THE list of presents to the Society was read, and a vote of thanks passed to the donors.

The following certificates were read :—

For the first time—E. Meusel, University College; A. W. Reinold, Merton College, Oxford; J. M. Muir, Shortland, Thames Gold Field, New Zealand.

For the second time—J. T. Bottomly, M.A., King's College, London; F. Braby, Mount Henley, Sydenham Hill.

For the third time—W. H. Deering, 12, Surrey Square, Old Kent Road, S.E.

The last-mentioned gentleman was then balloted for, and declared duly elected.

A paper by Messrs. E. T. Chapman and Miles H. Smith "*On some Decompositions of the Acids of the Acetic Series*" was then read. The following is an abstract :—

Action of Bromine on Acetate of Lead.—On adding bromine to an aqueous solution of acetate of lead, the authors found that a brown precipitate, consisting of peroxide of lead, was formed. On being warmed, the formation of the precipitate proceeded until 1 eq. of bromine had been added to 2 eqs. of acetate of lead. The following equation represents the decomposition :—

$$2C_2H_3PbO_2+H_2O+Br=2C_2H_4O_2+PbO+PbBr.$$

Action of Bromine on Acetate of Potash.—Two eqs. of bromine and one eq. of acetate of potash, and water, were sealed in a digestion tube for eleven hours. On cooling and opening the tube, CO_2 escaped, from which the mixture was freed by dilute caustic potash. The following change occurred :—

$$C_2H_3KO_2+2Br=KBr+CO_2+CH_3Br.$$

Action of Chlorine on Acetate of Potash in Aqueous Solution.—The action is strictly analogous to that of bromine. Bichloride of methylene is amongst the products of this reaction; and the authors think that, under appropriate circumstances, it would furnish a convenient source of this substance.

Action of Bromine on Valerianate of Soda in Aqueous Solution.—The products of this reaction are carbonic acid and bromide of butyl, more or less brominated. By fractional distillation of the liquid products, a body, having about the boiling point of bi-bromide of butylene, was obtained.

Iodine was found to have little action on the alkaline salts of the fatty acids.

Nitrate of Amyl and Acetic Acid.—On adding nitrate of amyl drop by drop to a warm mixture of twenty parts of glacial acetic acid and one of concentrated sulphuric acid, gases are evolved which consist of carbonic acid, a little nitrogen, a trace of binoxide of nitrogen, and an inflammable gas. The latter is soluble in solution of protochloride of iron, and proved to be nitrite of methyl. The liquid products of the reaction were acetate of amyl, with traces of acetate of methyl. Leaving out the amyl

and the sulphuric acid, which takes no part in this or the following reaction, though causing them to take place, the reaction was as follows :—

$$HNO_3+C_2H_4O_2=CO_2+CH_3NO_2+H_2O.$$

With the amyl—

$$C_5H_{11}NO_3+2C_2H_4O_2=C_2H_3(C_5H_{11})O_2+CH_3NO_2+ +CO_2+H_2O.$$

The acetate of methyl is supposed to owe its origin to a secondary reaction between the nascent nitrite of methyl and the excess of glacial acetic acid.

Nitrate of Butyl and Glacial Acetic Acid.—The action is precisely similar to the above, butyl being substituted for amyl.

Nitrate of Ethyl and Glacial Acetic Acid differ only from the above, in that the nitrate of ethyl decomposes, to some extent, by the heat of the reaction, and some of the products of the decomposition are obtained with the others.

Nitrate of Methyl and Glacial Acetic Acid.—The methyl of the nitrate of methyl is oxidised, and not the acetic acid. The authors express the reaction as follows :—

$$3CH_3NO_3=2CH_3NO_2+HNO_2+CO_2+H_2O.$$

Action of Formic Acid on Nitrate of Amyl.—In the presence of sulphuric acid, these bodies give rise to formiate of amyl, protoxide of nitrogen, carbonic acid, and water.

Mr. Perkin remarked that some time back Mr. Duppa told him that he had succeeded in obtaining the chlorides of the radicals from acetates and salts of the other acids. In the case of acetic acid, he obtained chloride of methyl; and in the case of succinic acid, he obtained chloride of ethyl. He (Mr. Perkin) made an examination of the chloride of ethyl, and found that it produced the normal hydride, and behaved just as the normal chloride of ethyl.

The President asked Mr. Chapman under what conditions he got the chloride of methylene by the action of chlorine upon potassic acetate, whether with the presence of water or not?

Mr. Chapman replied that all the decompositions occurred in the presence of water, with the exception of that in the case of glacial acetic acid. When the liquid was kept warm, and the chlorine passed into it pretty rapidly, being occasionally neutralised with potash, a notable quantity of chloride of methylene was formed, but it had to be looked for and condensed with care.

Mr. W. H. Perkin, F.R.S., then made some remarks in reference to a paper published in the Chemical News* by Fittig, "*On the Constitution of Coumarin and Coumaric Acid.*" Fittig assumed that coumarin was not formed from the hydride of aceto-salicyl, as had been stated, but that it resulted from the previous formation of coumaric acid. Some time since, Bertagnini stated that the hydride of benzoyl, when treated with chloride of acetyl, yielded cinnamic acid; and Fittig supposed that an analogous reaction took place between the hydride of salicyl and acetic anhydride, yielding coumaric acid, which, according to this view, would be oxycinnamic acid; this, by the further action of acetic anhydride, decomposing into coumarin and water. Coumarin would therefore be the anhydride of coumaric acid, standing in the same relation to coumaric acid as lactide did to lactic acid, thus :—

$$\underbrace{C_3H_6O_3}_{\text{Lactic acid.}}-H_2O=\underbrace{C_3H_4O_2}_{\text{Lactide.}}.$$

$$\underbrace{C_9H_8O_3}_{\text{Coumaric Acid.}}-H_2O=\underbrace{C_9H_6O_2}_{\text{Coumarin.}}.$$

But the question was whether coumarin had the properties of an anhydride at all. It was formed in the plant, in the presence of water; and it might be crystallised from water any number of times without being changed. If boiled in strong potash, a saline compound of coumarin was obtained; but directly an acid was added it separated unchanged. On adding nitrate of silver to a well-saturated solution of coumarin in soda, a yellow precipitate was produced, which, on analysis, gave the formula of coumarin, *plus* oxide of silver, $C_9H_6O_2Ag_2O$. If it were an anhydride, it would yield, with ammonia, an amide; but it did not do so, and he thought it was very evident that it was not an anhydride, as Fittig supposed it to be. In fact, it was not an easy matter to produce coumaric acid from coumarin, a boiling supersaturated solution of caustic alkali being required.

The President thought that Mr. Perkin's statements decided very clearly the point which had been raised by M. Fittig; but to complete some of his statements, he would like to ask him if he had recognised the properties referred to in the artificial as well as in the ordinary coumarin?

Mr. Perkin said that not only the artificial coumarin, but also the homologues formed compounds with caustic soda; and, in the case of the homologues, as the soda concentrated on boiling, the new compound separated as an oily layer, which, on cooling, became a sticky mass.

The President remarked that it was not conceivable that an anhydrous acid on boiling with water and an alkali should remain as an anhydrous acid capable of falling down as such upon the addition of an acid. He thought Mr. Perkin's evidence was quite conclusive.

Mr. Perkin, on trying Bertagnini's experiment with the hydride of benzoyl and chloride of acetyl, had not yet succeeded in obtaining cinnamic acid. He did not know whether any gentleman present had succeeded in obtaining it. He intended to repeat the experiment, and hoped to be more fortunate.

The President thought the absence of the action of ammonia on coumarin very conclusive that it could not be an anhydrous acid. He thanked Mr. Perkin for his communication, and announced that the next meeting would be held on the 15th inst.

* Vol. xix., p. 73.

FRENCH ACADEMY OF SCIENCES.

Monday, March 22nd, 1869.

Among the papers read we notice and briefly abstract the following:—"*On the Luminosity of Geissler Tubes by Friction.*" M. Alvergniat calls attention to the fact, that by simply rubbing one of the aforesaid tubes with the dry hand or a piece of silk, it exhibits the same phenomena of luminosity as if induced by electricity; the phosphoresence is, however, weak, but may be increased when within the tube are deposited substances which may become phosphorescent under the influence of electricity; when a tube so arranged is quickly rubbed it becomes within a few moments sufficiently luminous to serve as a faint light to see in a dark room.

Professor Dr. G. Chancel read a paper "*On the Ethers of the Propylic Alcohol derived from Fermentation.*" He begins with a statement that his researches on this subject are not yet sufficiently advanced to enable him to give complete details; propylic ether, or oxide of propyl—

$$\left.\begin{matrix}C_3H_7\\C_3H_7\end{matrix}\right\}O$$

is obtained by the action of iodide of propyl on the propylate of sodium. The oxide of propyl boils at about 86° C., and is a liquid exhibiting a high refractive power, slightly soluble in water. When the iodides of methyl, ethyl, and amyl, are suffered to act upon propylic alcohol in the presence of potasse, compound ethers are obtained,

e.g., propyl-methylic ether, or oxide of propyl and methyl—

$$\left.\begin{matrix}C_3H_7\\CH_3\end{matrix}\right\}O,$$

which boils at between 49° and 52° C.; propyl ethylic ether, or oxide of propyl and ethyl—

$$\left.\begin{matrix}C_3H_7\\C_2H_5\end{matrix}\right\}O,$$

which distils over at about 86° C.; propyl amylic ether, or oxide of propyl and amyl —

$$\left.\begin{matrix}C_3H_7\\C_5H_{11}\end{matrix}\right\}O,$$

which boils between 125° and 130° C. All these liquids have a density varying between 0·75 and 0·80, and exhibit a peculiar ethereal odour, as of ordinary ether mixed with some strange odoriferous principle.

M. E. J. MAUMENE presented a note "*On the Action of Corrosive Sublimate on Biniodide of Ethylen.*" The author first reminds, that some years ago he called attention to the fact that Berzelius and other authors had not paid proper attention to the reactions which in this instance take place, and Maumené comes to the conclusion that Berzelius had not even had prepared biniodide of ethylene, but mistaken iodoform in its stead. Sérullas, Mitscherlich, Bouchardat, and others, are then criticised, and the author next goes on with a series of theoretical reasonings not directly supported by experiments, but entirely founded on algebraico-chemical formulæ and reasoning; by these means he proves that, not as was stated by Berzelius, iodine of carbon is the result of the reaction, but that either a chloroiodide of ethyl or a chloride of ethyl is formed. The learned author ends his paper with this dictum: All chemical actions can be beforehand proved by theory; all formulæ which do not agree with it, will be rejected by experiments.

Monday, March 29th, 1869.

This meeting was one of very little interest for the scientific public generally; being chiefly occupied by the reading of correspondence relating rather to history.

The Rev. Father SECCHI, S.J., made an interesting communication in reference to the spectroscopical research made by him of the light emitted from the planet Uranus. This light, it appears, differs from that of the rest of the planets belonging to our solar system. The spectrum shown by the light of this planet, exhibits broad absorption lines; so that the yellow colour is almost entirely wanting—absorbed. While it is clear that the light emitted by this planet is reflected light from our sun, it is evident that the surface of the planet modifies that light in the same manner as do coloured bodies.

The Rev. Father also communicated, that the spectrum of R. Gemini, a so-called variable star, clearly exhibits, when at its greatest brightness, the lines due to hydrogen, magnesium, and sodium.

NOTICES OF BOOKS.

Town Life among the Poorest. By JOHN EDWARD MORGAN, M.A., M.D. London: Longmans, Green, & Co.

Dr. MORGAN read a paper on the dwellings of the poor in towns, at a meeting of the British Medical Association, Oxford, last August, and the pamphlet before us is a reprint of this matter. The author remarks that the housing of the poor, while beset with great difficulties, is most intimately connected with the future prosperity of the great mass of the people. In all our great cities, there are unhealthy quarters where the death rate is exceptionally high, and the reason of this, after careful inspection of many such places, Dr MORGAN believes is to be found in this statement. Bad air, or too little of it, kills the people.

Men will grow robust and vigorous, the author remarks, on very poor food, in very dirty cabins, and in very sorry attire, provided they enjoy a pure and bracing atmosphere, and the great physical development of the nations of the Hebrides and the western highlands of Scotland is cited as an example. In striking contrast to this, we find that in the Isle of St. Kilda, a small island, numbering about eighty inhabitants, three out of every five infants born alive are carried off a few days after birth by a convulsive affection allied to tetanus, the difference being apparently due to the huts having no smoke-hole in the thatch, and being rendered nearly impervious to air by double walls filled in with peat and soda, the object of which is to prevent the escape of smoke, and in due time the soot is collected and used as manure. Space will not permit us to deal with the details of the subject, but the data appear to be carefully collected, and we believe that those interested in the subject will find this little work worthy of their attention.

CORRESPONDENCE.

THE CHEMISTRY OF SUGAR REFINING.

To the Editor of the Chemical News.

SIR,—I was led to infer from the tenor of Dr. Wallace's communications, that he supposed the fact that "weak acids invert cane sugar" was insufficiently known, or he would not have repeated it so frequently. The *reductio ad absurdum* of his concluding remarks on this subject is rather an old ruse, and quite unworthy of him.

My remarks on the calcic carbonate with which sugar refiners of this country load the carbon surface of their bone-black, had reference to that which is derived from impurities in the crude sugar, and not that found in new bone-black. Dr. Wallace admits in his papers, that the amount of calcic carbonate existing in bone-black as in use in our refineries is a variable quantity, sometimes in excess, at others deficient; would it not, therefore, be preferable to get rid of it entirely (as it is not an *essential* constituent of bone-black, as far as the sugar refiners' use of it is concerned, as the Dr. would have us believe), either by the dry hydrochloric acid gas process, or by "others of a similar nature," *if such can be found*, and neutralise the acid of the crude sugar before submitting it to the action of the bone-black in the manner, as I have already said, which is in practice in other countries? Or the syrup of the crude sugar might advantageously be filtered through calcic carbonate in grains before passing it on to the bone-black filters: thus the complaints of "sour liquors and the occurrence of iron in the syrups" would cease.

I would, in conclusion, remind Dr. Wallace that the use of intemperate terms in a scientific discussion does not tend to bring conviction to the mind.—I am, &c.,

EDWARD BEANES.

Cordwalles, Maidenhead,
April 6th, 1869.

MISCELLANEOUS.

The Royal Polytechnic.—The most striking of the Easter novelties at this institution is the large induction coil, which has been made by Mr. Apps. It is 10 feet long and 2 feet in diameter. The core of soft iron weighs 123 pounds, and consists of wires each 5 feet long and ·0625 inches in diameter. The primary coil weighs 145 pounds, and is composed of 3,770 yards of copper wire. The secondary wire is 150 miles in length, and ·015 inches in diameter. The galvanic current for the primary coil is

supplied by 40 of Bunsen's cells. It is capable of producing a spark 29 inches long, and the flash will perforate plate-glass 5 inches thick. This huge and powerful coil will not only be valuable to Professor Pepper to illustrate the wonders of electricity to the general public, but we hope it will be used as a means for promoting scientific research.

The Gas Supply of the City of London.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has, in accordance with the provisions of the 71st section of the City of London Gas Act, 1868, reported on the quality of the gas supplied to the City of London during the months of January, February, and March of the present year, from which it appears that the illuminating power of the gas supplied by the several city companies is as follows:—

Illuminating Power in Standard Sperm Candles.

	Maximum.	Minimum.	Average.
City of London Gas Light and Coke Company	16·27	14·03	14·83
The Gas Light and Coke Company	16·28	14·38	15·26
Great Central Gas Consumers' Company	16·85	14·26	14·99

These are the results of examinations of each of the Companies' gas, three times daily, at intervals of not less than an hour, between the hours of five and ten o'clock in the afternoon. As regards the purity of the gas, he reports that ammonia has constantly been present in the gas of the Chartered and the Great Central Companies; but that the gas of all the companies has been always free from sulphuretted hydrogen. The amounts of sulphur present in the gas in other forms has been as follows:—

Grains of Sulphur per 100 cubic feet of Gas.

	Maximum.	Minimum.	Average.
City of London Gas Light and Coke Company	18·92	11·70	15·00
The Gas Light and Coke Company	24·15	15·75	19·49
Great Central Gas Consumers' Company	24·00	7·03	12·28

Report on the Sewage of the City of Melbourne.—Mr. W. Sydney Gibbons has kindly forwarded to us a copy of his report on this subject, from which report we briefly abstract the following:—It appears that as yet the City of Melbourne is not provided with a proper system of underground sewers, but a kind of cesspit filtration, suggested by Dr. Tracy, has been adopted, and Mr. Gibbons was requested to inquire into the efficiency of that system which, briefly described, has the following arrangement:—The water-closet is supplied by Yan Yean service, and by the bath-water of the house to the exclusion of kitchen slops. The cesspit, at a short distance from the closet, is a large stone chamber furnished with an iron grating, and a partition-wall dividing it into two parts except at the bottom. The dejecta are thus comminuted by the force of the stream of water beating against the partition-wall and the grating, so that before they reach the filter, the whole is homogeneous liquid. The filter, at the bottom of which the mixture enters, is a covered pit with an iron grating at a short distance above the bottom and another near the top. Between the two are layers of road-metal, oyster-shells, and a mixture of animal and vegetable charcoal. The author of this report made a very minute inspection of all things connected with this subject, and took at different places in Melbourne, samples of filthy sewage water in open gutters, which samples were analysed; the samples all agreed herein that they contained a large amount of organic matter and solid residue, while fœtid exhalations and gases were freely given off; for comparison's sake the Yan Yean water from the main pipes was analysed, and this water found to be clear and sweet, yielded a solid residue of 8·736 grains to the gallon, of which 2·152 grains are organic matter. This water was free from ammonia and sulphuretted hydrogen; microscopic research of this water, as well as of the sewage water, proved the former to contain only such infusion as may always be met with in fresh sweet natural water, but in the case of sewage, myriads of all kinds of lower animal forms of life such as accompany foul and decaying organic matter were met with. As to the cesspit filtration arrangement, it was fully proved to be chemically inoperative, and mechanically incomplete. The lengthy and copious report, which is chiefly of local interest, proves that the city of Melbourne is sadly behind in proper sanitary arrangements, and deficient in the requisite means to carry off its foul and refuse matter.

CONTEMPORARY SCIENTIFIC PRESS.

After an experiment of more than eighteen months, we have decided to discontinue this department of the journal, and we have made arrangements for giving abstracts of the contents, instead of the titles merely, of all original articles in the leading Foreign Chemical journals. Those articles which are too comprehensive to be condensed will, if they are of sufficient importance, be translated in full, and inserted as soon as possible after their publication abroad. These abstracts will be printed in smaller type, thereby increasing the available size as well as the value of the Chemical News.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Analysis of a Meteorite (*Cosmos*), known as the meteorite of Wisconsin, U.S. Specific gravity, 7·82; composition in 100 parts:—Iron, 91·03; nickel, 7·20; cobalt, 0·53; phosphorus, 0·14; copper, a trace; insoluble in hydrochloric acid, 0·45.

Decomposition of Alkaline Chlorides.—(*Moniteur Scientifique*, No. 295).—According to Messrs. Kuentz and Jossinet, the decomposition of alkaline chlorides is readily and economically effected by the combined agency of heat and high-pressure superheated steam; the chlorides are brought to fusion, and while in that state a jet of steam, as just described, is forced through the fused mass; hydrochloric acid is formed together with a caustic alkali, or if, at the same time, carbonic acid is injected along with the steam, the carbonate of the alkali is formed.

Reduction of Chloride of Silver.—(*Zeitschr. f. Anal. Chem.*)—According to Gräger, an ammoniacal solution of chloride of silver is very completely reduced by placing therein tolerably large lumps of zinc; the solution is best placed in a wide-mouthed glass-stoppered bottle, and this requires to be shaken frequently; there should be zinc in excess. When the fluid, on a drop thereof being tested, no longer yields a precipitate with hydrochloric acid, the operation is finished; the silver is then separated by pouring the fluid off from the spongy mass, and washing by decantation; the pieces of zinc having been removed, the spongy silver is washed with pure strong hydrochloric acid, and next with water. The silver thus obtained is, according to the author chemically pure.

On the Action of Sulphuretted Hydrogen Gas upon Oxide of Iron and Hydrated Oxide of Iron.—(*Journ. f. Gasbeleuchtung*, 1869, No. 2).—M. E. Brescius, at Frankfürt-on-the-Maine, has instituted a series of long-continued experiments in reference to the above subject and its special bearing upon the illuminating gas purifying process, known as "Laming's," when lime purifiers are applied not simultaneously for the purpose. As result of the researches and experiments of Brescius we find—1. That when sulphuretted hydrogen gas acts upon hydrated oxide of iron at the ordinary temperature of the atmosphere, there is formed sesqui-sulphuret of iron, Fe_2S_3, according to the formula—$Fe_2O_3 + 3HS = Fe_2S_3 + 3HO$. 2. Perfectly dry sulphuretted hydrogen gas has no action whatever upon perfectly dry oxide of iron. The experiments are fully described in a lengthy paper.

New Preparation of Dithionate of Soda, &c.—(*Les Mondes*).—On shaking nitrite of oxide of amyl with a solution of bisulphite of soda, the dithionate is obtained in the form of a white crystalline mass. The method for the preparation of hyponitric acid, by means of nitric acid and arsenious acid, does not give a pure product. If nitrite of oxide of amyl is treated with chlorhydric acid, hydrate of oxide of amyl and chloride of ammonium are obtained; no amylamide can be found in the products. By causing hyponitric acid to act on essence of gaultheria, nitro- and binitrosalicylate of oxide of methyl are produced with a separation of oxide of nitrogen. Nitrosopiperidine and nitrosodiæthyline, obtained by MM. Th. Wertheim and A. Geuther, must be regarded as nitro bases. These compounds are kinds of amides of nitric acid, and are obtained by a loss of water in the corresponding nitrites.

Preparation of Carbonic Acid.—(*Revue Hebd. de Chim.*)—Messrs. Rousseau and Piedbœuf propose to obtain carbonic acid from sulphate of lime (plaster of Paris), by heating in retorts, arranged and made as those in use at gas works, a mixture of the material alluded to and charcoal or coke. The decomposition which ensues is represented by $SO_3CaO+C_2=SCa+2CO_2$.

A Peculiarity concerning Anthracite.—(*Revue Hebd. de Chim.*)—In the mountains near Aosta, Italy, an anthracite is found, which, on account of containing too much iron pyrites, has very little value as fuel. According to the observations of Deyees, this substance has antiseptic properties, and has been applied to kill insects and as a suitable manure to vineyards; he also observed that, when given to pigs, at a dose of 20 grammes daily, it greatly assists the fattening of them.

Analysis of the Slime and Mud of the River Nile, by M. A. Houzeau.—(*Comptes Rendus*).—One hundred parts of air-dried mud contain:—Water, driven off at 110° C., 7·70; clay and sand, 62·71; oxide of iron, magnesia, and small quantity of phosphate of iron, 14·70; carbonates of lime and iron, 0·57; alumina, 8·27; sulphate of lime, 0·56; organic matter and loss, 5·49; nitrogen in 100 parts, 0·0504. The author has also determined the composition of the water of the Nile during its periodical flood, and has paid special attention to the quantity of nitric acid and ammonia; among the curiosities of the results is, that the Nile carries every week into the Mediterranean a quantity of 6,000,000 of kilogrammes of ammonia.

Fluorine in the Brain.—Professor Horsford, of Yale College, has tried to detect fluorine in the human brain, he was induced to do so by the fact that fluorine so frequently accompanies phosphoric acid in the mineral kingdom, and also on account of the large proportion of phosphoric acid found in the brain and nerves by Von Bibra and others. After having very carefully ascertained that the reagents he was about to apply were quite free from fluorine, the learned professor operated upon a human brain which had been long kept in spirits of wine, but which in consequence of neglect had, by the evaporation of the liquor, become wrinkled up and dry. A series of carefully made experiments proved undoubtedly the existence of fluorine in the brain.

New Series of Platinum Compounds.—(*Poggendorff's Annalen*, vol. 136, part i., 1869.—R. Schneider has discovered a new series of crystallisable platinum compounds, wherein stannous oxide and stannic acid play an important part. He first describes a compound containing 29·10 per cent platinum, 57·05 per cent tin, 13·85 per cent oxygen. This is called by him stannate of stannous protoxide of platinum. On treating this compound in the moist state with an aqueous solution of an alkali, soda for instance, he obtains a compound containing in 100 parts—Platinum, 50·0; tin, 29·3; sodium, 6·0; oxygen, 13·5; this is $NaPtSn_8O_{16}$, or stannate of protoxide of platinum and soda. The author further describes at very great length kalium platin-oxysulpho-platino-stannate, that is to say a compound containing in 100 parts Pt, 59·47, Sn, 11·86, K, 7·76, S, 19·35, O, 1·79, and also natrium platin-oxysulpho-platino-stannate, composed in 100 parts of Pt, 61·41, Sn, 12·04, Na, 4·73, S, 19·66, O, 1·80.

Reduction of Oxides by Hydrogen.—(*Poggendorff's Annalen*, vol. 136, part i., 1869).—M. W. Müller has instituted a series of experiments with the view to determine precisely the temperature at which the oxides of metals begin to be reduced by hydrogen gas. He has experimented with oxides of various metals prepared in various ways, and also determined the effect of other gases, nitrogen, and aqueous vapour, upon the temperature of incipient reduction. Oxide of iron prepared by cautiously heating metallic iron in contact with air was found to get reduced at 285° C.; the same oxide prepared from nitrate of iron was reduced at 286°; when rather moist hydrogen was applied and the oxide of iron prepared from oxalate of the protoxide, the temperature of reduction was found to be 278°. Oxide of copper prepared from the sulphate of that metal and precipitated by caustic soda, and previously heated to 300°, was found to become reduced at 135°; strongly ignited oxide of copper became reduced at 142° on an average of five experiments; oxide of cobalt becomes reduced at about 132°; oxide of zinc could not be reduced at a temperature whereby glass became fused; oxide of tin, about 174°; oxide of lead, at from 310° to 315°; peroxide of mercury, 230°; oxide of silver, at between 73° and 78°. The experiments have been extended to the chlorides and sulphides of some metals. Chloride of gold does not appear to be acted upon below 200°, but at a higher temperature an explosion took place. The action with chloride of platinum was rather strong at 85°, and rather violent at 165°; reduction of the metal took place. The chlorides of silver and lead are not reduced below the boiling point of mercury, but require a red heat; sulphide of gold is reduced at 200°, while sulphide of platinum is reduced at the ordinary temperature, sulphuretted hydrogen gas being formed in both cases.

Quantitative Estimation of Tartaric Acid.—(*Pharm. Zeitschr. f. Russ.*, 1869, No. 1).—Dr. Martenson, First Assistant in the Chemical Laboratory of the Pharmaceutical Institute of Dorpat, Russia, has made a series of experiments, with the view to obtain a trustworthy and readily executed method of quantitative estimation of tartaric acid. After first ascertaining by a series of experiments that tartrate of lime is less soluble in water than is commonly reported in books (he ascertained that 1 part of the aforesaid salt requires at 18° C. 2388·26 parts of water for complete solution), he discovered the almost complete insolubility of the tartrate of lime in alcohol of 85 per cent strength. In order to estimate the tartaric acid in tartrate of potash, for instance, the salt is dried at 100° C., dissolved in a small quantity of distilled water, next pure chloride of calcium solution is added, with the precaution to avoid excess thereof, afterwards a few drops of lime-water are added, and the porcelain capsule wherein this operation is performed is left standing for some hours. A crystalline precipitate is thus obtained; it is collected on a filter previously dried at 100° and weighed; the supernatant fluid is first poured upon the filter, then the precipitate is collected and washed with strong alcohol, the precipitate and filter are thoroughly dried at 100°, the precipitate is weighed as—

$$2CaO,C_8H_4O_{10}+8HO.$$

It is of importance to take care to use a porcelain basin the glaze of which is quite free from cracks, otherwise the precipitate has a strong tendency to adhere to such portions of the basin. When either hydrochloric or nitric acids are present along with tartaric the fluid is first nearly neutralised with pure carbonate of lime and warmed to expel carbonic acid, while the last traces of acid are removed with lime-water. The presence of either chloride of ammonium or chloride of calcium in excess interferes with the correctness of the results and makes it necessary to add alcohol to the liquid to be operated upon. Results are accurate when proper care is taken.

Detection of Sulphur by means of Potassium or Sodium.—(*Zeitschr. f. Anal. Chem.*, 1869).—Dr. Schönn, at Stettin, recommends the use of either of these two metals for ascertaining the presence of sulphur in oxidised or non-oxidised state in inorganic compounds; a small quantity of the substance to be tested for sulphur is pulverised and placed in a dry test tube, a small piece of potassium or sodium is then added, and upon it a small quantity of the powdered substance which is to be tested is again placed in the test tube; heat is applied, reduction takes place, and sulphide of the metal is formed. The test tube, after cooling, having been broken, its contents are placed in a small quantity of water rendered acid by a few drops of sulphuric acid; sulphuretted hydrogen is evolved. If the quantity of sulphide formed is likely to be very small, nitroprusside of sodium should be used as a test. Care should be taken that only small quantities of substance are operated upon in this manner, especially since substances as realgar, orpiment, and others containing sulphur and arsenic, at the same time, violently explode and detonate when ignited with the above-named metals.

For Detecting Sulphur in Organic Substances, especially of Animal Origin.—(*Zeitschr. f. Anal. Chem.*, 1869).—The same process is available. Hair and feathers, and dry skin and nails, may be at once submitted to ignition with the metal. White of egg, emulsin, saliva, and muscle, should first be calcined on a piece of platinum, and the animal charcoal so obtained be ignited along with potassium or sodium. In most cases of this kind, nitro-prusside of sodium will be required to make the presence of sulphur absolutely evident.

Detection of Phosphorus by means of Magnesium.—(*Zeitschr. f. Anal. Chem.*, 1869).—Dr. Schönn, at Stettin, found that when previously well dried (previous ignition is often required) inorganic combinations of phosphorus and phosphates, even if they are mixed with sulphates, are ignited in pulverised state in a test tube with small quantities, say from 5 milligrammes to 1·5 centigrammes of magnesium wire, ribbon, or better still, pure magnesium in powder, there is formed phosphide of magnesium. After cooling, the fused mass, on being moistened with water, will disengage phosphuretted hydrogen gas, which, in many instances, will be found to be the spontaneously inflammable variety of that compound. Phosphorus may be detected in the same way in organic substances; as, for instance, brains, muscle, &c.; but these should be previously calcined, and the dry animal charcoal so obtained submitted to the experiment.

Detection of Ozone in the Atmosphere.—(*Zeitschr. f. Anal. Chem.*, 1869).—Dr. Van Huizinga has made a series of experiments to compare the relative value of mixed iodide of potassium and starch, and of protoxide of thallium, for the detection of ozone in the atmosphere. He comes to the conclusion that neither of these two reagents are quite so reliable in all respects as is desirable, but the latter deserves preference. A series of comparative experiments were made by the author and Dr. Van Ster; the former being on the island of Texel, the latter at the Helder, and experimenting with paper prepared with iodide of potassium and starch. The thallium paper was impregnated with a preparation obtained by precipitating the sulphate of thallium with baryta water. The paper contained, for every square centimetre surface, about 1 miligramme of protoxide. It is well known that protoxide of thallium is changed by ozone into the brown oxide of that metal.

Detection of Picrotoxin in Beer.—(*Zeitsch. f. Anal. Chem.*)—Köhler's method for the detection of picrotoxin, the active and poisonous principle of cocculus indicus, is based upon the fact, that when ammonia is present, acetate of lead precipitates as insoluble matter from beer, such substances as dextrin, gum, glucose, while the picrotoxin, which is not thus precipitable, can be removed by means of ether from an acidified fluid. The beer to be tested is first mixed with ammonia until it is distinctly alkaline, the ensuing precipitate of phosphates is allowed to settle, and after the fluid has become clear, a boiling hot and concentrated solution of acetate of lead is cautiously added as long as a precipitate ensues; excess of lead solution should be avoided. The precipitate so obtained should be collected on a filter and washed with hot alcohol for a short time; from the filtrate, the lead is removed by means of sulphuretted hydrogen gas, the sulphide of lead removed by filtration, and the filtrate evaporated on a water-bath to the consistence of a syrup; the fluid obtained is treated with ether, the latter separated from the aqueous residue, and the ether removed by evaporation. Picrotoxin reduces the oxide of copper to protoxide, is soluble in sulphuric acid, exhibiting a saffron yellow coloured fluid. When bichromate of potash is added to the sulphuric acid solution, a violet colouration ensues, which ends by becoming bright green. If the beer contains strychnia simultaneously with picrotoxin, or extract of cocculus indicus, the strychnia remains behind in the syrupy fluid which remains after the ether is separated therefrom by means of a stoppered funnel.

Molybdic Acid a Test for Morphia.—(*Zeitschr. f. Anal. Chem.*, 1869).—M. Almén has thoroughly tested the value of Fröhde's test for morphia—sulphuric acid which is contaminated with, or contains molybdic acid, purposely added. A beautiful purple tint is produced when such acid is brought into contact with either pure morphia or its salts.

Solubility of Silico-fluoride of Potassium in Dilute Hydrochloric Acid.—(*Zeitschr. f. Anal. Chem.*, 1869).—Since hydro-fluosilic acid is sometimes resorted to in the quantitative estimation of potash, it should be borne in mind that, even though alcohol be used to increase the insolubility of the silico-fluoride of potassium, F. Von Stolber has observed that 1 part of this salt is dissolved by 409 parts of weak hydrochloric acid, containing 1·8 per cent real acid; while the stronger the acid becomes, the greater also the solubility, even at a temperature of 14° C.

Ebullition of Water.—(*Poggendorff's Annalen.*)—In reference to the well-established fact that water, after having been deprived of air as much as possible, either does not boil at all when heated, or does so with violent sudden starts and concussions, some experiments have been made by Kremers, who observed that, in order to assist in expelling air from water, the addition of spirit of wine, in the proportion of one part of the latter to three of the former, is very useful. He cautions against a danger which exists when such a mixture is heated too rapidly, since it is very apt to boil over, especially after a portion of the spirit has evaporated. It is rather curious that, though both the water and spirit of wine employed were pure, the mixture, when boiling, should assume a greenish yellow hue, which disappears again on cooling; the boiling point of the fluid easily becomes as high as 109°. As a result of a large number of experiments, the author finds that water, as fully deprived of air as possible, may be heated as high as from 180° to 200° C., without boiling permanently.

Elementary Organic Analysis.—(*Zeitschr. f. Anal. Chem.*)—Messrs. Stern and Calberla recommend the use of pure metallic silver instead of copper turnings in the elementary organic analysis when, nitrogen being present in the substance submitted to combustion, pure, clean metallic copper-turnings are, as is well known, placed in the front end of the combustion tube in order to reduce any binoxide of nitrogen which may be formed. The authors prefer silver on account of the non-necessity for reducing this metal again by means of hydrogen after the combustion is ended. Silver, according to their researches, answers all the purposes of copper admirably well.

Testing Opium.—(*Zeitschr. f. Anal. Chem.*)—Professor Schneider has proposed in the 6th revised edition of the Pharmacopœia Austriaca, the following method for testing the goodness of opium. Ten grammes of previously dried and powdered opium is treated with a mixture of 150 grammes of distilled water, to which 20 grammes of pure hydrochloric acid, sp. gr. 1·12, is added; the residue, after extraction, should not exceed 4·5 grammes weight; to the acid fluid 20 grammes of common salt are added, and the precipitate thereby caused is collected, after 24 hours, on a filter, and the latter washed with a solution of common salt; to the filtrate, ammonia is added, and the fluid left standing again for 24 hours; the crystals which have separated are collected, re-dissolved in acetic acid, and precipitated with ammonia; the precipitate so obtained is washed, dried, and weighed; its weight should not be less than 1 gramme.

NOTES AND QUERIES.

Substitute for Black-Lead for Stoves.—A concentrated solution of silicate of potash or soda, to which may be added mineral substances as colouring matter; for instance—for white, tin-ash, precipitated sulphate of baryta, oxide of zinc, and the like; for red, Venetian red and divers shades of oxide of iron, also red ochres; blue, ultramarine, cobalt blue, and such like substances; but the question is, even if the drying goes on well, will not the dry material scale off readily again; of course it will somewhat depend on the more or less roughness of the surface of the iron. Paint made with boiled linseed oil is out of the question where heat has to be endured, and, moreover, it sticks to iron, in consequence of the peculiar properties of the oil itself. There is no patent for the employment of silicate of soda.

Skeleton Lectures.—There is now some hope that scientific instruction will in future form no inconsiderable part in the educational curriculum of our public schools and schools in general. I believe the extension of this important branch of knowledge may be greatly extended amongst those who have passed their school days without this advantage if some enterprising philosophical instrument maker, would supply skeleton lectures with the necessary instruments and apparatus to illustrate them on loan and reasonable terms. "Skeleton Sermons" are much in vogue, and why not skeleton lectures on science, well arranged and adapted for the special experiments to make them both interesting and intelligible. I am quite sure there are hundreds of intelligent persons who now devote themselves to "Penny Readings" would be too glad to give brief lectures on popular science, if they could only hire the necessary apparatus, &c, to give them interest; a scientific lecture without experiments, is like a body without life. I shall be glad to see this suggestion carried out.—W. Little, Heckington Hall, Lincolnshire.

Detection of Minute Traces of Hydrocyanic Acid.—Pagentecher some time ago pointed out that guiaicum resin with hydrocyanic acid, and some salt of copper, caused a blue colouration. More recently Schönbein has shown how to prepare test paper of great sensibility with tincture of the above named resin, for detecting hydrocyanic acid; but the following observation of the same sensibility of the shavings from which the resin is derived, especially with the shavings of the lignum sanctum, is, I believe, new. Moisten a few shavings with a weak solution of sulphate of copper, place then on a piece of perforated paper over the mouth of a bottle containing cherry-laurel water; after a few minutes the colouration will take place. By the same way I have confirmed M. Louget's observation of the existence of a minute dose of a cyanide in salivation. Moisten a few shavings with the weak solution of copper, upon simply spitting upon it, immediately the blue colour will appear.—S. Comne, London, April 5, 1869.

On a Momentary Molecular Change in Iron Wire.—Mr. Gore, F.R.S., whilst making some experiments on heating strained iron to redness by means of voltaic electricity, observed that, on disconnecting the battery and allowing the wire to cool, during the process of cooling the wire suddenly elongated, and then gradually shortened until it became quite cold. The amount of elongation of the wire during the momentary molecular change was usually about 1-240th part of the length of the heated wire; the molecular change evidently includes a diminution of cohesion at a particular temperature during the process of cooling, and it is interesting to notice that at the same temperature during the heating process no such loss of cohesion nor any increase of cohesion takes place; a certain temperature and strain are therefore not alone sufficient to produce it, but the condition of cooling must also be included. A large number of experiments were made with great care with wires of palladium, platinum, gold, silver, copper, lead, tin, cadmium, zinc, brass, German-silver, aluminium, and magnesium, but in no instance could a similar molecular change to that observed in iron be detected. This molecular change would probably be found to exist in large masses of wrought-iron as well as in small specimens of wire, and would come into operation in various cases where those masses are subjected to the conjoint influence of heat and strain, as in various engineering operations.

MEETINGS FOR THE WEEK.

Monday, 12th.—Medical, 8.

Tuesday, 13th.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."
—— Photographic, 8.

Wednesday, 14th.—Society of Arts, 8.
—— Geological, 8.
—— Microscopical, 8.

Thursday, 15th.—Royal Institution, 3. Professor Tyndall, "On Light."
—— Royal, 8.30.
—— Chemical, 8.
—— Royal Society Club, 6.

Friday, 16th.—Royal Institution, 8. W. Carruthers, Esq., "On the Cryptogamic Forests of the Coal Period."

Saturday, 17th.—Royal Institution, 3. A. Geikie, Esq., "On the Origin of Land Surfaces."

TO CORRESPONDENTS.

Communications have been received from O. Lodge; W. H. Walenn; Dr. E. Fleischer; R. Calvert Clapham; W. H. Perkin, F.R.S.; W. Smith; J. Barrow; H. McLeod; L. W. Leeds; C. H. Osborn; Dr. Letheby; A. G. Pritchard; J. W. Young; L. Walters; E. T. Chapman; C. S. Watson; J. Fisher; Pierre Clavel (with enclosure); W. M. Watts; E. Smith, M.A.; J. W. Slater; H. J. Jones; W. H. Darlington; G. Cranston (with enclosure); J. C. Lee (with enclosure); The Bede Metal Company; W. Wallace; H. C. Sorby, F.R.S.; A. H. Church, M.A.; Dr. E. Davy (with enclosure); F. S. Silitoe; Gossage and Sons (with enclosure); Mottershead and Co. (with enclosure); W. J. Morgan; E. Bird; and Dr. Röhrig.

BOOKS RECEIVED.

Thèses Presentées à la Faculté des Sciences de Paris, pour obtenir le Grade de Docteur es Sciences Physiques. Par M. Stanislas Meunier. Paris: Gauthier-Villars.

Power Without Fuel: an Investigation of the Means by which it may be obtained from the Heat of Natural Sources. By James S. Baldwin. New York: Willham H. Winans and Co.

History of Chemical Theory. By Ad. Wurtz. Translated and Edited by Henry Watts, B.A., F.R.S. London: Macmillan.

On the Application of the Conversion of Chlorates and Nitrates into Chlorides, and Chlorides into Nitrates, to the Determination of Several Equivalent Numbers. By Frederick Penny, Esq.

Proceedings of the American Association for the Advancement of Science. Cambridge: Joseph Lovering.

Lectures on Ventilation. By Lewis W. Leeds.

Observations on some of the Fundamental Principles and Existing Defects of National Education. By Neil Arnott, M.D., F.R.S., &c. London: Longmans, Green, and Co. 1869.

The Elasticity, Extensibility, and Tensile Strength of Iron and Steel. By Knut Styffe. Translated from the Swedish by Christer P. Sandberg; with a Preface by John Percy, M.D., F.R.S. With 9 lithographic plates. London: John Murray.

THE CHEMICAL NEWS.

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ANOTHER NEW ELEMENT ASSOCIATED WITH ZIRCONIUM.

From a letter received from Mr. H. C. Sorby, dated April 13th, we learn that he has discovered spectrum evidence to prove that, independent of jargonia, zircons from different localities contain two distinct earths, occurring in very variable proportion, so that some appear to contain little or none of one, and others to be chiefly composed of it.

ON THE PITCHSTONES OF THE ISLAND OF ARRAN.

By J. WALLACE YOUNG.

The pitchstone dykes and veins in Arran are of great interest to the geologist, the mineral being comparatively rare in Britain.

Pitchstone appears of a dark blackish green colour, almost like a piece of bottle glass, sometimes with small specks, and, occcasionally, large crystals of felspar disseminated in the base, giving it a more or less porphyritic texture.

When small chips, or properly prepared sections are examined microscopically, it is seen to consist of a colourless glassy base—probably a hydrated felspar, and having, according to Mr. Sorby, no action on polarised light. Scattered throughout are great numbers of dark green prismatic crystals, crossing in all directions, and often in stellate groups. On applying heat to a thin splinter, water is expelled, and it becomes opaque, the opacity being due to the minute vesicles produced by the expulsion of the water.

B.B. pitchstone becomes white, and fuses with difficulty to a very vesicular glass. Fracture, conchoidal, splintery.

The finely elutriated mineral is acted on to a slight extent by digestion with HCl; with HS_2O_4 the action is a little greater.

Pitchstone, when weathering and decomposing, becomes opaque and greyish white, and is not difficult to pulverise. In this state it is acted on very considerably with HCl; the SiO_2 separating partly in a gelatinous form. A specimen of weathered pitchstone from the Corrugills shore, dried at 100° C., lost 11·69 per cent of water on ignition.

The following table shows the compositions of four different specimens:—

	I.	II.	III.	IV.
Silicic acid	72·55	73·00	71·94	71·27
Alumina	12·08	12·27	12·31	11·60
Ferrous oxide	1·50	1·27	1·31	1·69
Lime	0·50	0·50	0·80	0·95
Potash	4·32	3·92	4·27	4·17
Soda (by difference)	3·64	3·92	4·00	3·45
Water	5·41	5·12	5·37	6·87
	100·00	100·00	100·00	100·00

No. 1. From the large vein on the Corrugills shore. This forms a broad, almost horizontal band in front of the sandstone cliffs. A few small felspar crystals scattered throughout the smooth, blackish green mineral. Sp. gr. 2·336.

No. 2. From the great vein, about 30 feet broad, which crosses the old Lamlash Road at right angles. More porphyritic in character than any of the others. Sp. gr. 2·327.

Nos. 3 and 4. From Moneadh-Mhor Glen. The two pitchstone dykes are well exposed in the bed and banks of the stream. No. 3. Blackish green; smooth. Sp. gr. 2·343. No. 4. Greyish green; texture somewhat coarse. Appears as if in a state of incipient decomposition. Sp. gr. 2·323.

From the microscopical examination of a great many different varieties, it would appear that the more porphyritic kinds show the greatest number of green prismatic crystals. In the specimens Nos. 1 and 3, they are not so numerous; but higher microscopic powers show immense quantities of very small, needle-shaped crystals disseminated throughout, and frequently surrounding the larger crystals like a fringe, appearing to have separated out and grouped themselves in this manner, the base in the neighbourhood being comparatively free from them. The larger crystals have apparently been first formed, and in some cases, have acted as a sort of nucleus for the smaller ones.

ON SOME NEW ANILINE DYES.

By W. H. PERKIN. F.R.S., Sec. C.S.

At a recent meeting of the Chemical Section of the Philosophical Society of Glasgow, Mr. Perkin made some observations upon artificial colouring matters, which he illustrated experimentally.

The first remarks were upon the action of chloride of lime on aniline, the formation of Runge's blue, and its conversion into mauveine, being shown. The particulars of these results have already appeared in the Chemical News.

An instance of how little the replacement of hydrogen by bromine in a colouring matter will at times influence its colour and properties, was shown and remarked upon by the formation of a blue the author had produced from a salt of rosaniline and bromaniline. This blue possesses both the colour and most of the properties of ordinary triphenyl-rosaniline, although it must contain bromophenyl in place of phenyl, thus:—

$$\underbrace{\left.\begin{matrix}C_{20}H_{16}\\C_6H_5\\C_6H_5\\C_6H_5\end{matrix}\right\}N_3}_{\text{Tri-phenyl-rosaniline.}} \qquad \underbrace{\left.\begin{matrix}C_{20}H_{16}\\C_6(H_4Br)\\C_6(H_4Br)\\C_6(H_4Br)\end{matrix}\right\}N_3}_{\text{Tri-bromophenyl-rosaniline.}}$$

This substance appears to differ from the ordinary blue only in being less soluble in alcohol.

An experiment was then made in reference to the peculiar property mauveine possesses of becoming colourless, like indigo, with reducing agents, and then assuming its ordinary colour again when exposed to the oxidising influence of the air, a property showing this colouring matter to belong to a different class of compounds to rosaniline.

The next subject was in relation to a colouring matter which had been obtained several years since by Mr. Perkin, but only in small quantities, in the preparation of aniline purple with bichromate of potassium and a salt of aniline. This substance produces, upon silk or cotton, shades similar to those obtained with safflower, and owing to a somewhat improved process for its production, endeavours are now being made to introduce it into the arts, especially as it possesses advantages over safflower. It is, however, still difficult to manufacture; it is called aniline pink, and sometimes safranine.

This substance is at present under examination; it does not appear to be at all related to rosaniline, but to possess properties similar to those of mauveine, as it gives the same reactions with acids, and with reducing agents becomes colourless, but, when exposed to the air, rapidly

assumes its original tint, exactly in the same manner as the mauve.

Like most of the coal-tar colours, it is an organic base. It forms very soluble salts, most of which are crystalline, and possessed a green metallic lustre.

One of the most remarkable of its properties is the peculiar orange-coloured fluorescence of the alcoholic solution of its salts. This was illustrated by means of the magnesium lamp.

Mr. Perkin has not yet decided upon the formula of this colouring matter, but is at present engaged with the subject. It appears to contain much less carbon than mauveine.

PRELIMINARY NOTICE

ON THE MINERAL CONSTITUENTS OF THE BREITENBACH METEORITE.*

By Professor N. STORY MASKELYNE, M.A.

THIS meteorite, which belongs to the rare class intermediate between meteoric irons or siderites, and meteoric stones or aërolites, was found in Breitenbach in Bohemia.

It is a spongy metallic mass, very similar to the siderolite of Rittersgrün in Saxony, the hollows in the iron being filled by a mixture of crystalline minerals. These minerals seem to consist almost entirely of two; and the present notice deals with these two minerals.

1. One of them is of a pale green colour, crystallising in the prismatic system, and presenting at once the formula of an augitic mineral and a crystalline form nearly approaching that of olivine.

The analysis of this green mineral gave, from 0·4127 grm.,—

		per cent.
Silica	0·2315	56·101
Magnesia	0·1247	30·215
Ferrous oxide ..	0·0560	13·583
	0·4122	99·899

results which correspond very nearly with an Enstatite of the formula $(Mg\frac{3}{4}Fe\frac{1}{4})SiO_3$. The specific gravity is 3·23.

2. The other mineral is one of very great interest. It is, in short, silica crystallised as tridymite. In bulk it forms about a third part of the mixed crystalline mass.

The crystals are very imperfect; but measurements accord with those of an hexagonal crystal.

A section made for examination in the microscope showed two small crystals in which the axis happened to be normal to the section. Light traverses these crystals with equal brilliancy during the rotation of the crystal between crossed Nicol prisms. That this was due to gyratory polarisation, and of a right-handed kind, was shown in the following manner:—

A comparative experiment was made with two sections of quartz of opposite qualities, and of the requisite thickness, to give the "sensitive tint" with crossed Nicols; and below these were placed two thin sections of right-and-left gyrating quartz, giving an orange tint. The two minute microscopic sections gave, on comparison of the colours in the centre of the field, in each case, unmistakable evidence that the gyration was similar to that of "right-handed" quartz.

There can be no doubt from these results that this mineral is silica in the form of its opaloid crystal, to which Von Rath has given the name of Tridymite.

The analysis of the mineral gave, by distillation of the silica as silicic difluoride, and subsequent determination as potassic fluosilicate, 97·43 per cent of silica; the remainder being oxide of iron and lime. Thus 0·3114 grm. gave—

		per cent.
Silica	0·3034	97·430
Ferric oxide	0·0035	1·124
Lime	0·0018	0·578
	0.3087	99·132

A second analysis gave 99·21 per cent silica, 0·79 of residue.

Its specific gravity, as determined from a very small amount of the mineral picked under the microscope, was 2·18; a second determination made on a larger amount gave the value 2·245. That of tridymite is 2·295 to 2·3. This may be taken as evidence that the mineral is not quartz, the specific gravity of which is 2·65. Von Rath's experiments were made on a rather less pure form of tridymite.

* Abstract of a paper read before the Royal Society, April 8th, 1869.

ON THE

DISTILLATION OF DENSE HYDROCARBONS AT HIGH TEMPERATURES,

TECHNICALLY TERMED "CRACKING."

By S. F. PECKHAM.

IN the American reprint of the CHEMICAL NEWS for June of this year, an article appears "On Naptha and Illuminating Oil from Heavy California Tar," by Prof. B. Silliman, copied from the *San Francisco Bulletin*. In the September number of the same journal, an article appears "On the Distillation of Hydrocarbons," by Joseph Hirsch, Ph.D., in which the results obtained by Prof. S. are subjected to criticism, and certain statements made in reference to the subject of a most extraordinary character.

At the same time that Mr. Corning was engaged upon the experiments, the results of which form the subject of Prof. Silliman's paper, I was engaged upon experiments of a similar character for the Geological Survey of California, the results of which have not yet been published.* These results differed somewhat from those obtained by Prof. S., as also the method by which they were obtained. I shall, therefore, give a brief summary, both of method and results, and compare the conclusions to be derived from them with the statements made by Dr. Hirsch.

Those who first attempted the manufacture of commercial oils from crude California materials, when operating with the upright still in common use for the manufacture of Pennsylvania oils, encountered an apparently insurmountable obstacle, viz., a large proportion of the distillate was neither light nor heavy, neither burning oil nor lubricating oil, but an oil intermediate in density between the two, and therefore not merchantable. The difficulty was so far overcome by enclosing the stills in brick-work, heating them entirely by radiant heat, and distilling very slowly, that the amount of heavy lubricating oil was largely increased, and the "middlings" correspondingly diminished. The yield of illuminating oil however, was very slightly increased, and it was for the purpose of securing a larger yield of that material, that my experiments were undertaken. I had at first intended to subject them to Mr. Downer's process of slow distillation in a high, upright still, the top of which was exposed to radiation. The small quantity of crude material at my command (5 gallons of each variety) rendered this operation exceedingly difficult to conduct successfully, and it was with extreme satisfaction that I saw at the time, in the October number of the CHEMICAL NEWS for 1866, an announcement that Mr. Young of Glasgow had

* The volume of Reports of the Survey on "Economical Geology," containing these results, is now ready for the press, but its publication is delayed by the failure of the last California Legislature in making the necessary appropriation.

obtained a patent for the manufacture of illuminating oils from heavy paraffine oils, by distillation under pressure. It was necessary that I should operate on a small quantity at a time, and also, that I should subject the four or five different samples which I had to the same treatment, in order that I might compare the results, and judge of their relative value. For that purpose I contrived the apparatus described in the September number of this Journal for 1867, which, so far as I know, has but one fault, viz., the chamber of the valve is too small, and should be enlarged sufficiently to enable the pressure to be regulated by weights instead of by a spring.

With a pressure of between 30 and 40 pounds per square inch (the exact amount was not ascertained) the following results were obtained :—

Percentage Results of Distillation under Pressure.

	I.	II.	III.	IV.
Volatile impurity, consisting of air and water	—	—	—	12·5
1st pressure distillation of crude material	91·—	87·66	82·86	72·2
Coke and loss at do.	9·—	12·34	17·34	15·5
1st fractionation of sp. gr. 43° B. = 0·810 ..	42·—	56·72	40·33	16·7
Leaving heavy residue for re-distillation	49·—	30·94	42·33	55·3
Which yielded, by 2nd pressure distillation	44·15	27·84	58·09	49·8
2nd fractionation of sp. gr. 43° B. = 0·810 ..	12·25	6·96	9·52	12·4
Total crude illuminating oil..	54·25	62·68	49·85	29·1
Loss in treatment of do. 3-100ths	1·62	1·88	1·49	0·9
Total yield of refined oil, ...	51·25	60·70	48·36	2·82
Total crude lubricating oil	31·85	20·88	28·57	37·4
Loss in treatment of do. 3-100ths	0·95	0·62	0·85	1·1
Total refined lubricating oil	30·90	20·26	27·72	36·3
Yield of refined illuminating oil, sp. gr. 43° B.	51·25	60·70	48·36	28·2
Yield of refined lubricating oil, sp. gr. 23° —25° B.	30·90	20·26	27·72	36·3
Loss in treatment	2·61	2·50	2·34	2·05
Coke and loss in distillation	18·24	16·54	21·58	33·5
Yield of illuminating oil by ordinary process	15·00	20·00	3·00	2·0

No. 1 was an oil procured from one of the tunnels of the Hayward Petroleum Company, of a specific gravity of 0·9023, yielding by distillation in a common still about 15 per cent of light oil, of a specific gravity of 0·810, with about 40 to 50 per cent of "middlings" and 20 per cent of light lubricating oil.

No. 2 came from the celebrated Pico Spring, yielding the lightest oil of any natural outcrop in Southern California. Its specific gravity was 0·8932, and it yielded to treatment by the ordinary method only about 20 per cent of illuminating oil of the proper density.

No. 3 was from the Canada Laga, of specific gravity of 0·9184, and yielding by the ordinary process only 3 per cent of illuminating oil.

No. 4 was a sample of Maltha from the same spring as that operated upon by Prof. Silliman. Its specific gravity was 0·978, and it yielded about 2·5 per cent of illluminating oil.

This table exhibits the results of actual experiment, not of theory ; and while they differ from those obtained by Prof. Silliman, the difference is in degree and not in kind, and is without doubt due to the superiority of the apparatus used by myself, and to a higher degree of pressure employed. Both series of experiments confirm each other, and alike prove that dense petroleums and a thick heavy tar—as thick as ordinary molasses—which yield practically little or no illuminating oil by ordinary treatment, by distillation under pressure are subjected to what is technically termed "cracking" and made to yield from 28 to 60 per cent of oil fit for burning, and rendered thereby nearly as valuable as the crude oils of Pennsylvania.

Dr. Hirsch criticises these experiments as not being executed under circumstances "parallel to the distillation on a large scale." He then states, that, during the distillation of hydrocarbons on the large scale, "the process of 'cracking' always takes place in some degree," as "all hydrocarbons of high boiling points contained in such mixtures are, during distillation, exposed to varying degrees of temperature below their own boiling point, as long as those hydrocarbons of lesser gravity and lower boiling point have not been removed by distillation." He further states, that "it is this exposure to a lower degree of heat than corresponds to the distilling point of an oil of definite gravity, which comprises the operation of 'cracking.'" Again, he states, that during slow distillation in the enormous stills now being introduced, "cracking" takes place without any "special efforts" to produce such a result, "while only a small portion distils over as paraffine oil, that being due to over-heating." He next states, that by rapid distillation of a small quantity, the different hydrocarbons which make up the petroleum come over unchanged, and that the difference between this last-named distillation and the former, is the same as the one between distilling coal for the production of illuminating gas, and that for producing coal oil ; the former producing a dense tar, being carried on in small low retorts, and the latter in revolving retorts of large capacity. "In these the oily vapours are exposed to a cooler temperature than their own with every revolution of the retort, and are in this manner broken up into oils of lighter gravity."

He then gives a number of rules, the result of his own experience.

"1st. * * * the more the temperature of the actual boiling point of oil of definite gravity is above the temperature to which the same oil is raised, the greater is the quantity of light oil obtained.

"2nd. The gravity of distillate resulting from reduction of temperature will be directly proportionate to said reduction. * * * In distillation, the temperature, therefore, should always be reduced to the boiling point of the oil of the specific gravity desired.

"3rd. The difference between the temperatures of the two boiling points, viz. of the oil being subjected to distillation and of the derived distillate, is in direct proportion to the height of the still employed, or to the facility for cooling the upper portions of the still.

"4th. The intensity of the process of 'cracking' is proportionate to the suddenness with which the oil vapours are condensed before leaving the still.

"5th. The difference in gravity between that of the oil distilled and the desired distillate is in direct proportion to the quantity of water produced in the process.

"These laws are the same with hydrocarbons distilled under the ordinary atmospheric pressure, as with those distilled in a vacuum, or under increased pressure."

It is very rarely that as many errors are included within as little space, and the entire discussion exhibits in a remarkable degree to what totally erroneous conclusions the results of close observation and experience may lead when explained upon a false hypothesis.

The operation of "cracking," as conducted by Mr. Downer, consists in a slow distillation of oils of high specific gravity, and high boiling point, in a still furnished with a high dome, the outer surface of which is freely exposed to radiation. As distillation proceeds, those oils which are condensed at the temperature at which the dome is maintained, instead of passing into the worm and thence into the receiver, collect in drops upon the surface of the dome, and fall back upon the surface of the oil beneath, which has meantime become heated above their boiling points. Mr. Young distils the oils under pressure, thereby vapourising them at a temperature above their normal boiling points.

It is therefore obvious that the primary and essential condition of "cracking" is simply to subject the oils to a temperature above their boiling points, or in other words, to super-heat their vapours. It will be found that, for oils of the same density, the higher the temperature to which they are raised, or at which they are distilled, the lighter will be the product ; and that to produce an oil of given density, the heavier oil must be raised to a certain fixed temperature, the intensity of heat depending on the lightness of the oil required.

Now it is evident that Prof. Silliman could not subject five or ten gallons of Maltha to experiment strictly analogous to Mr. Downer's process, the two elements of time and large capacity of apparatus being practically unattainable when manipulating so small a quantity. He

could, however, follow Mr. Young's process strictly, using from 10 to 15 pounds pressure per square inch. My own results were obtained by using from 30 to 40 pounds pressure per square inch, and operating upon only 1,500 c.c. at a time.

Dr. Hirsch is correct in stating that during the distillation on the large scale, this process always obtains action in some degree, but his reasoning is utterly at fault. So, too, in his explanation of the fact, that "cracking" takes place in large stills without any special effort to secure such a result. The real explanation lies in the fact, that the upper portion of stills in ordinary use is generally exposed to atmospheric currents and radiation. With such an arrangement it is impossible, upon Mr. Downer's plan, to prevent more or less condensation upon the dome, and consequent "cracking," especially toward the end of the operation, in stills of the enormous capacity of 40,000 gallons, where all the conditions essential to his process are present. It was in stills set in this manner that the heavy California oils were first distilled, and in which they were "cracked" to an oil of medium density; but when the sides and domes of the stills were surrounded with brick-work, the vapours were no longer condensed, and they passed unchanged into the receiver.

Dr. Hirsch is again in error in supposing that paraffine oils are produced by a high temperature. I am told that Mr. Downer has made illuminating oils, by "cracking" solid paraffine wax by means of his process. The paraffine lubricating oils of commerce are now most successfully produced from coals, by distilling the material in large kilns, in which combustion takes place at the upper surface, and the draft is conducted downward, insuring the expulsion of the volatile products at the very lowest temperature possible.

He is yet again in error in the analogy which he assumes to exist between rapid and slow distillation of petroleum and the distillation of coals in small retorts to produce illuminating gas, and in revolving retorts to produce oil. Rapid distillation "cracks" the oil, because it necessitates increased temperature to force the vapours from the still. Such as been my experience repeatedly on both the large and small scale. Slow distillation yields the hydrocarbons unchanged, provided the vapours have ready egress from the still, because distillation is then carried on at the lowest temperature attainable. Small retorts are used for the manufacture of gas, in order that the coal may the sooner be raised to the red-heat, and the greatest possible "cracking" effect be experienced, while revolving retorts are used for the manufacture of oil, not that the charge may be repeatedly cooled, but in order that it may be uniformly heated, avoiding the necessity of over-heating the portion next the fire, in order that the upper portion may be heated sufficiently.

His first and second rules, when reduced to plain English, assert that that "cracking" may be produced by refrigeration. Following their lead, in order to produce from paraffine wax the lightest member of the naphtha series isolated by Prof. Warren, and boiling at 0° C., the paraffine should be immersed in melting ice. According to these rules, the best method of producing illuminating gas from crude petroleum would be to subject the oils to the action of a refrigerating mixture of solid carbonic acid and ether, instead of allowing them to drip upon red-hot coke.

His third rule is correct, as the lower the temperature at which the top of the still is maintained, the lower will be the boiling point of the liquid resulting from the condensation of the vapours that escape.

His fourth rule is too obscure in its signification to admit of criticism.

His fifth rule is of the most extraordinary character. Chemistry is not yet ready for the anouncement of the transmutation of one element into another, and such transmutation must certainly take place if *water* can be produced by distillation of volatile *hydrocarbons*, with exclusion of *oxygen*. So, too, is it almost equally difficult to imagine how any general laws can be "the same" for two processes so diametrically opposed as distillation in a vacuum and under pressure.

I desire in this connection to note a few suggestions which have occurred to me in reference to this subject. In the last edition of Prof. Dana's Mineralogy (1868), he has classified the results obtained by Profs. Warren and Storer, and arranged the hydrocarbons isolated by them in three groups, viz., the Naphtha and Beta-naptha series, and the Pittoleum group. The first two are isomeric, the last contains more carbon in proportion to its hydrogen. The members of the Pittoleum group at present isolated are doubtless the lower members of a large group, the higher members of which have very high boiling points; or perhaps still there is another group containing a still larger proportion of carbon. As the different members of these groups decrease in density, the proportion of hydrogen increases, and as they increase in density the proportion of carbon increases. The process of "cracking" Pennsylvania oils, therefore, is simply subtraction of carbon; and it appears from the results of experiment and analysis, that each additional atom of carbon is held by a feebler affinity than the last, consequently the stability of the members increases as the proportion of carbon decreases. The lower the member is in the series, the stronger is the affinity of the hydrogen for the carbon, and consequently, the higher is the temperature required for the production of the member next below it. Thus it is that over-heating dense paraffine oils produces medium or illuminating oils; over-heating illuminating oils produces still lower and more volatile liquids; at a still higher temperature the products become gaseous, and at an excessively high temperature, light rather than heavy carburetted hydrogen gas is produced.

In the absence of actual demonstration by fractionation, I am led to believe from the behaviour of California petroleums, that they do not contain either the Naphtha or Beta-naphtha series in appreciable quantity; nor do they contain the members of the Pittoleum group yet isolated in large proportion, but are doubtless made up of the higher members of that group, or a still more highly carbonised and unstable group not yet described, with which is mingled one or more nitro-hydrocarbons yet more easily decomposed. Be this fact or fancy, the appearance and physical properties of the refined pressure distillate from these oils, lead to the opinion that it is made up of the same members of which refined Pennsylvania petroleum is composed. The lightest oils existing in crude California petroleum change in a few weeks, after treatment, to a dirty yellow colour, even when tightly corked and exposed only to the light. A bottle of refined pressure distillate in my possession has now been prepared nearly two years, yet its colour has scarcely changed perceptibly.

By Prof. Warren's process of fractionation only a trace was eliminated from any of my samples of crude California oil under 150° C., yet in one instance, when my valve accidentally stuck so that the pressure was very considerably increased above 40 pounds, the vapours when they escaped passed through the worm uncondensed at 8° C., and melted the lead pipe at its point of connection with the retort; proving that, as in the case of the heavy paraffine oils, decrease in the density of the distillate follows any considerable increase in the temperature of distillation.

I hope at some future day to be able to fractionate both the crude California petroleums, and the products of their distillation under pressure, and thus obtain some additional facts in reference to this interesting question.—*American Journal of Science, January*, 1869.

Cement for Leather is best made by mixing with ten parts of sulphide of carbon one part of oil of turpentine, and adding thereto so much gutta-percha, as, by dissolving in this mixture, will form a tough, thickly-flowing liquid, like treacle. The cement is applied to both pieces to be joined, the surfaces brought into contact, and pressure applied until the joint is dry. One essential requisite of success is the perfect freedom of the surfaces to be joined from all grease.—*Coach makers' Journal, U.S.*

ON THE

ESTIMATION OF COPPER IN ORES,

BY CERTAIN METHODS FOR WHICH A PREMIUM HAS BEEN AWARDED.*

In that portion of central Germany known as the Mansfeld District, there is found a vein containing metallic ore, which is worked for copper and silver. Since, generally speaking, this ore is extremely variable in value, and since it becomes more and more a matter of immense importance to be able to judge without loss of time of the quantity of metal contained in the ore brought up from various portions of the mines, the want of good means for ascertaining this speedily was more and more felt. It need hardly be said that there exist a great many methods for the quantitative estimation of copper in its various combinations; but it is equally true that only very few of these are fit for technical application; it being moreover especially desirable that persons not professional assayers or chemists, but miners† of ordinary intelligence, should be enabled to make the required assays. In the laboratory of the mine owners at Eisleben there has been in use for the poorer copper ores a method of assaying introduced by the late H. Rose, while the raw products of the furnaces were assayed according to a Swedish method. The objection against both these methods, which were executed by fitly educated men, was, that for a large number of assays, such as are daily required to be finished there, it took too much time, too much room, and too many hands and apparatus. Rose's method just alluded to is the following: the finely powdered ore is acted on by aqua regia, to which some sulphuric acid is added; next, evaporation to dryness, dissolving in acidulated water, separation of the copper by means of sulphuretted hydrogen, and weighing the sulphide of copper after having been ignited and cooled in a current of hydrogen gas. Although the method here described is a good one, it implies for correctness the condition that no metals precipitable by sulphuretted hydrogen, and non-volatile when ignited in a current of hydrogen, be present. As regards the Mansfeld ores, the absence of such metals has been over and over again proved; but for all this, it appears that now and then small quantities of molybdenum have affected the correctness of the results. The Swedish method, however excellent its results, is very cumbrous, and embraces too many different operations to admit of being very readily and thoroughly mastered by many operators.

The difficulty as regards the Swedish method is the precipitation of the metallic copper: the solution from which it takes place, by means of metallic iron, should neither be too hot nor too cold; a too large excess of acid also is objectionable. It requires, moreover, a special tact to see when all the copper has been precipitated, since the iron must then be removed from the solution at once, and the acid solution decanted from the copper; in one word, with the greatest possible care it was not very easy to work the two methods just briefly alluded to, with operators who were not specially educated for such work.

Under these circumstances, the directors of the Mansfeld copper mines issued, in May, 1867, the following advertisement in four scientific German papers:—"A premium of 300 thalers (£45) will be granted to the party who discovers a method of assaying the Mansfeld copper ores, provided the following conditions are complied with:—(*a*) the assay, and all the operations belonging thereto, must not take longer time than from five to six hours; (*b*) one man must be enabled to execute daily eighteen assays, without too great a strain upon his faculties; (*c*) the limits of accuracy, must be strictly kept within the following amounts:—for minerals containing 1 pound of copper to the hundredweight, 10 per cent; for 2 pounds to the hundredweight, 6; for 3 pounds, 5; for 4 pounds, 5; and above that figure, 4 per cent." It was moreover stated that the method to be given might be a combination of several methods already known.

Sixteen answers have been received by the directors. Six of the proposed methods were based on the volumetrical estimation of copper by means of cyanide of potassium or sulphide of sodium. One proposed method was based upon the estimation of iodine previously set free, by means of hyposulphite of soda; one titration with solution of iodine; one titration with permanganate of potassa; one titration with xanthogenate of potassa; one determination of copper as oxide; two estimations of copper as sulphide, combined with ignition in current of hydrogen gas; two a so-called process of dry assay; one a process by electrolysis.

In order to select from this material, and report upon the best and most suitable plan, a committee of three gentlemen was appointed; two of them practical assayers and copper-smelters, the third the well-known Dr. Böttger. This committee decided—

(*a*). That any process which included many operations, and consequently took up too much time, should be excluded.

(*b*). No process to be admissible which involved the use of varying quantities of ore, since it is impossible to judge by the sight about the quality of the Mansfeld ore.

(*c*). Any process is also inadmissible wherein, for the burning off of the bituminous organic matter of the ore, more expensive substances, as, for instance, chlorate of potassa, are recommended.

(*d*). Any process is likewise inadmissible whereby the reactions take place with great violence, and may thus induce explosions.

(*e*). Such methods are inadmissible, also, wherein, for quantities of 5 grammes and more, is recommended the treatment with acids, and evaporation to dryness after addition of sulphuric acid.

(*f*). On sanitary grounds, and in reference to the large number of operations and assays daily required, such processes are also inadmissible wherein hyposulphite of soda is applied so that sulphurous acid is given off; while processes wherein large bulks of sulphuretted hydrogen are used are equally discarded.

(*g*). Methods whereby copper is separated from the earths, oxides of iron, and other metallic oxides, either by ammonia alone or in addition thereto of carbonate of ammonia, tartaric acid, &c., are also discarded; because the precipitated oxide of iron or alumina never fails to carry down some copper also; and, also, because oxides like those of zinc, nickel, and cobalt, by remaining in solution, affect the accuracy of the estimation of copper.

(*h*). Such estimations of copper are also discarded whereby it is collected in a spongy state, or as sulphide upon previously dried and weighed filters.

(*i*). The dry assay is also discarded, as, even if it were possible to obtain therewith correct results, it would entail in the consumption of fuel, breaking up of apparatus, crucibles, &c., and the use of various fluxes, a too great expenditure.

(*k*). Such processes are also discarded as require in the operator too much knowledge and scientific training.

(*l*). Such as require the aid of assistants are also discarded.

It is clear that many parties who had entered into the competition on this subject could not, owing to the severe conditions, remain in the field. The umpires instituted a large number of assays with divers samples of ores, which had been previously analysed, and the composition of which had been determined with rigorous accuracy, but had not been communicated to them. Their researches proved that, as regards the methods of volu-

* Translated from the original German from the *Zeitschrift für Analytische Chemie Von Fresenius*, 1869, No. 1.

† Miners in Germany are all men who must have enjoyed a good education, and all are under the orders and control of scientific and practical men as their superior officers.

metric estimation, only such deserve any confidence when the copper has been first previously separated in a metallic state, is next re-dissolved, and that then only the titration method with cyanide of potassium is a fit and serviceable one.

After a long series of experiments, the umpires decided in favour of Dr. Steinbeck's method in the first place, but were at the same time so satisfied about M. C. Luckow's plan, that to that gentleman, who holds the position of chief chemist to the Cologne-Minden Railway Company at Deutz, a premium has also been awarded. It may be briefly said here, that his method is based upon the estimation of copper by electrolysis.

We will give next week full details respecting Dr. Steinbeck's method; after which, M. Luckow's will be described in full.

(To be continued).

ON THE

FORMATION AND PHENOMENA OF CLOUDS.*

By J. TYNDALL, L.L.D., F.R.S.

It is well known that when a receiver filled with ordinary undried air is exhausted, a cloudiness, due to the precipitation of aqueous vapour diffused in the air, is produced by the first few strokes of the pump. It is, as might be expected, possible to produce clouds in this way with the vapours of other liquids than water.

In the course of some experiments on the chemical action of light, I had frequent occasion to observe the precipitation of such clouds in the experimental tubes employed. The clouds were generated in two ways. One mode consisted in opening the passage between the filled experimental tube and the air-pump, and then simply dilating the air by working the pump. In the other, the experimental tube was connected with a vessel of suitable size, while the passage between the vessel and tube could be closed by a stopcock. The vessel was first exhausted. Turning on the cock the air rushed from the experimental tube into the vessel, the precipitation of a cloud within the tube being a consequence of the transfer.

The clouds thus precipitated differed from each other in luminous energy, which is, of course, to be referred to the different reflective energies of the particles of the clouds, which were produced by substances of very different refractive indices.

Different clouds, moreover, possess very different degrees of stability. Some melt away rapidly, while others linger for minutes in the experimental tube, resting upon its bottom as they dissolve like a heap of snow.

The clouds exhibit a difference in texture. A certain expansion is necessary to bring down the cloud. The moment before precipitation, the mass of cooling air and vapour may be regarded as divided into a number of polyhedra, the particles along the bounding surfaces of which move in opposite directions when precipitation actually sets in.

Every cloud particle has consumed a polyhedron of vapour in its formation; and it is manifest that the size of the particle must depend, not only on the size of the vapour polyhedron, but also on the relation of the density of the vapour to that of its liquid. If the vapour were light and the liquid heavy, other things being equal, the cloud-particle would be smaller than if the vapour were heavy and the liquid light.

The case of toluol may be taken as representative of a great number of others. The specific gravity of this liquid is 0·85; water being 1·0, the specific gravity of its vapour is 3·26, that of aqueous vapour being 0·6. Now, as the size of the cloud particle is directly proportional to the specific gravity of the vapour, and inversely proportional to the specific gravity of the liquid, an easy calculation proves that, assuming the size of the vapour polyhedra in both cases to be the same, the size of the particle of toluol cloud must be more than six times that of the particle of aqueous cloud. Aqueous vapour is without parallel in these particulars—it is not only the lightest of all vapours, but also the lightest of all gases, except hydrogen and ammonia. To this circumstance the soft and tender beauty of the clouds of an atmosphere is mainly to be ascribed.

The sphericity of the cloud particles may be inferred from their deportment under the luminous beams. The light which they shed when spherical is continuous, but clouds may also be precipitated in solid flakes, and then the incessant sparkling of the cloud shows that its particles are plates, and not spheres. Some portions of the same cloud may be composed of spherical particles, others of flakes, the difference being at once manifested through the calmness of one portion of the cloud and the uneasiness of the other.

* Abstract of a paper communicated to the Royal Society, January 28th, 1869.

PROCEEDINGS OF SOCIETIES.

PHARMACEUTICAL SOCIETY.

Wednesday, April 7th, 1869.

G. W. SANDFORD, Esq., President, in the chair.

MR. HOWARD made a few remarks with reference to the cultivation of cinchona in India, dwelling more particularly on the necessity of discriminating between the embarassing number of varieties and species now under cultivation, owing to the great variation in the amount of their respective yields. In respect to the effects of cultivation on the productiveness of the bark, it appeared that the cinchonine increased in greater proportion than the quinine.

Dr. REDWOOD read a paper in which he proposed that the question of the expediency of changing our present system of weights and measures for the metric system should be discussed. The abstract question itself was, without doubt, accepted on all sides; the only objection to be raised was a question of the balance of advantages attending its adoption and the inconveniences to be encountered in introducing it. With the public it was only a question of familiarity, and it was proposed on many sides to patch the old system rather than revolutionise and adopt a new system in its entirety. In deciding against such patchwork, and in favour of the metric system, entire dissatisfaction with the old, or unqualified approval of the new system was not expressed. It was sometimes lamented that our measures were not accurately defined on scientific principles, whereas it was asserted the standards of the metric system were so defined. This was an entirely erroneous assumption, and was only true of our system when the inch was said to be the measure of three barleycorns, the foot the length of a man's foot, &c. The metre of the metric system was not selected because it was the most useful measure, but because it was the 10-millionth part of a certain portion of the earth's surface. In basing the standard measure of our system on the vibrations of a second's pendulum, we have not sought a unit of measurement, but simply to determine the length of the inch from which all the old-established measures might be derived. Moreover, it had been found preferable to refer measures to a carefully preserved artificial standard, so that the metric system does not owe its superiority to its natural standard, but to the comparability of its divisions, which enable it to be adopted as an international system. The author also recommended that pharmaceutical chemists should be impressed with a definite notion of the integral parts of the system, not simply acquainted with its principles, and mentioned a variety of plans by which this object

could be attained. He considered that it would greatly facilitate matters if the names now in use in France were anglicised so as to conform more to English notions. The valuable opinions of the Master of the Mint were also quoted and discussed by the author. As a partial measure, the total abolition of troy weights had recommended itself to Dr. Graham's mind; and Dr. Redwood inferred from the general tone of his report that no sweeping change could be expected just now.

After a slight discussion, in which Dr. Attfield, Mr. Haselden, and Mr. M. Carteighe took part, it was proposed and carried, that the further discussion of the subject be adjourned; and the President announced an extraordinary meeting to be held for this purpose on Wednesday evening, May 5th.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, March 5th, 1869.

"*On some further Results of Spectrum Analysis as applied to the Heavenly Bodies*," by WILLIAM HUGGINS, F.R.S. —The speaker commenced by saying that four years ago he had the honour to give in the theatre of the Royal Institution an account of the results of an attempt to apply the method of analysis by the prism, for which science is indebted to Kirchhoff, to the light of the heavenly bodies. It was the speaker's purpose to describe, on the present occasion, some of the results which had been obtained in his observatory since the spring of 1865. The peculiar suitability of spectrum analysis as a mode of investigation of the bright objects in the heavens had been confirmed, not only by the gain of further information of the chemical and physical constitution of some of these immensely distant bodies, but also by knowledge of another kind which this elegant and searching method of analysis had revealed to us.

The speaker then described the three typical forms under which all spectra may be classed, and the interpretation which our present knowledge enables us to give of these different spectra when the light is emitted by bodies rendered luminous by heat. The spectra of fluorescent and phosphorescent bodies were not to be described.

1. *A continuous spectrum without dark or bright lines* shows, as a general rule, that the luminous source is in the solid or liquid state. In certain exceptional cases, however, a gas may give a spectrum which is apparently continuous. Dr. Balfour Stewart pointed out that, as gases and vapours possess a power of general absorption, in addition to the selective absorption peculiar to each gas, a gas when luminous would emit light of all refrangibilities, producing a continuous spectrum, in addition to its spectrum of bright lines, and further that the intensity of this continuous spectrum would be in proportion to the opacity of the gas. The researches of Plücker and Frankland have shown that, under certain conditions of density and temperature, the bright lines of hydrogen expand so as to produce a spectrum which is apparently continuous.

2. *A spectrum of bright lines* indicates that the luminous body is in the state of gas. Each gas and vapour has its own set of lines. The lines may be greatly modified, or even altogether changed, under different conditions of temperature and density, as is well known in the case of nitrogen, the vapour of sulphur, and some other substances; but throughout all these changes, each gas behaves in a way peculiar to itself. There appears to be one exception to the statement that a spectrum of bright lines is peculiar to luminous gas. Bunsen found that when solid erbia is heated to incandescence, the continuous spectrum contains bright bands.

3. *A continuous spectrum interrupted by dark lines* informs us that the light has passed through vapours at a lower temperature than the source of light. As the kinds of light absorbed by each vapour correspond precisely with the set of bright lines which that vapour emits when in the luminous state, it is possible to learn if the vapours are those of any of the substances with which we are acquainted.

The speaker said that, following the arrangement adopted in the former discourse, the most important recent information obtained of the *fixed stars* results from the application of prismatic analysis in a new direction. Under certain conditions the spectrum of a luminous body is adapted to tell us whether that body is moving towards or from the earth. The importance of information on this point will be seen from the consideration that the proper motions of the stars represent that part only of their whole motion which is transverse to the line of sight; for any motion they might have in the visual direction, toward or from the earth, would not cause any visible displacement of the star, and could not therefore be ascertained by the ordinary methods of observation.

As it is upon the length of the waves, or upon the number contained in the series that enters the eye, or falls upon the prism, in a second that a judgment is formed of the colour of the light, or its place in the spectrum is determined, it follows that any circumstance which would alter the length of the waves *relatively to the observer*, or, in other words, cause a larger number of waves to enter the eye in a second of time, would cause a change in the colour or refrangibility of the light so far as the observer is concerned. It is obvious that if the observer advances to meet the light, a longer series of waves fall upon the retina in a second of time, each wave appears shorter, and he ascribes to the light a higher refrangibility than he would do if he were not advancing to meet the light. If he were receding from the star, an alteration of refrangibility in the opposite direction would take place. The same effect would ensue if the luminous source were in motion. Thus, to a swimmer striking out from the shore, each wave appears shorter, and he passes a greater number of them in a given interval in proportion to his speed through the water.

Illustrations were given of this principle, which was first suggested in 1841, by Doppler, by means of an analogous change of pitch in sound. Two tuning-forks sounding in unison were moved rapidly towards and from the audience, when beats were heard, which told of a difference of pitch produced by the opposite motions of the forks.

As there exists beyond the visible spectrum, at both ends, a store of invisible waves, these would be advanced or degraded into visibility, in proportion as the colours of the spectrum were altered, and no change of colour would be perceived. It is therefore essential, before we can apply this method to detect the radial motion of the stars, that we know the original refrangibility of some part of the light at the moment it left the star, and also that we are able to recognise this particular part of the light again in the spectrum of the star's light. When, by means of a group of dark or bright lines, we learn the presence of a terrestrial substance in the star, both these conditions are fulfilled.

Of all the stars which the speaker had compared with terrestrial elements, when working with his distinguished friend Dr. W. A. Miller, Treas. R.S., Sirius, which contains four very strong lines which are due to hydrogen, appeared the most suitable for this investigation. The apparatus employed, and the special precautions which were taken to ensure the perfect coincidence in his instrument of the stellar line with those of the substance compared with it, were described by the speaker, who stated that, after a prolonged comparison, extending over many weeks, of the line of hydrogen in Sirius in the green, at the place of F in the solar spectrum, with the line of terrestrial hydrogen, he found that the line in the star had undergone a shift in the spectrum equal to a difference of wave length, which would correspond to a motion of recession between the star and the earth of 41 miles per second. The speaker had obtained evidence from experiment that this shift was not due to unsymmetrical ex-

pansion of the line in hydrogen as the density is increased. The greater width of this line in Sirius than in the solar spectrum would show that the hydrogen in Sirius, though at a pressure considerably less than that of our atmosphere at the surface of the earth, is more dense than the hydrogen in the solar atmosphere by which the dark line F is produced. This conclusion is in accordance with the presumably enormous mass of Sirius, as suggested by its great intrinsic splendour.

The earth at the time of observation was moving from Sirius at about 11 miles per second, which would leave 30 miles as due to the star. A further correction is required for the solar motion in space, which is believed to be towards Hercules, with a velocity of 4 or 5 miles per second. The whole of this must therefore be deducted, leaving about 26 miles as the motion of Sirius from the earth in the line of sight. The true motion of the star would consist of this radial motion compounded with the transverse motion of from 24 to 40 miles per second, which is shown by its proper motion.

The speaker then described a further examination of the nebulæ (about fifty have been successfully observed) with a more powerful spectroscope, which confirms his previous conclusion that these bodies consist mainly of the gases nitrogen and hydrogen. He also found that when the spectra of these gases are made faint by the removal of the spark to a distance, all the lines are extinguished, with the exception of the one line in each spectrum which is found in the nebulæ. If such an extinction takes place in the case of the nebulæ, since they are objects of sensible size, it must be attributed to a power of extinction of light existing in cosmical space.

Observations of four comets have been made. A large part of the light of these strange objects was found to be peculiar, and therefore emitted by the cometary matter. Brorsen's comet at its return in 1868, and a comet discovered by Winnecke, gave a spectrum of three bright bands. The spectrum of Winnecke's comet (comet II., 1868) was found to be identical with the spectrum of carbon as it appears when the induction spark is taken in olefiant gas, and in some other compounds of carbon. The spectrum of the comet was compared directly in the instrument with the spectrum of olefiant gas.

The speaker then described some observations of the sun. He found that while the solar lines are for the most part thickened when viewed in the light from the umbra of a spot, the lines C and F, due to hydrogen did not appear to be altered. This observation is of interest in connection with the constitution of the solar prominences as shown by the observations of the great eclipse of last August. The speaker, nearly three years ago, at the same time that he had independently made attempts to see the prominences by means of the spectroscope, also tried the method of using absorbing media, by which the parts of the spectrum where the bright lines occur might remain, while all the rest of the spectrum was extinguished. In this way the faint prominences would be rendered visible, in consequence of the much greater relative diminution of the intensity of the illuminated screen of air, which, on ordinary occasions, conceals them from view. Recently he had succeeded in viewing the outline of these objects by means of a coloured glass combined with a spectroscope with a wide slit. He expected to be able to view these objects by means of coloured media alone.

FRENCH ACADEMY OF SCIENCES.

Monday, April 5.

At this meeting a large number of papers were read, but the major portion does not belong to the sciences treated of in the Chemical News. Among those which may interest our readers, we briefly mention the following:—

A very short communication from Dr. Maumené, in respect of "*The Action of Potassium upon Dutch Liquid.*" Many of our older readers will perhaps recollect the very sharp discussions on this subject which, a long time ago, took place between Dumas and Liebig; Maumené now proves that both those eminent *savants* were right, since the diversity of the results obtained by them is entirely due to the fact that one of them applied the liquid in excess, the other the metal.

M. Gaugain read a paper wherein he proves that, even with feeble galvanic currents, the electrodes are always polarised, and that this polarisation is constant when the relation between the intensity and the resistance remain constant.

M. Berthelot read a paper "*On the Influence of Pressure on the Reaction between Carbon and Hydrogen,*" of which paper we propose to give a full report afterwards. We intend to do the same with the paper read by MM. Schützenberger and Naudin, "*On the Acetic Acid Derivatives of the Carbo-Hydrates.*"; we therefore briefly now state that, according to their researches, starch paste has to be considered as an alcohol, since it can combine with acids and form definite compounds.

M. Dubrunfaut made some rather unexpected statements in respect of the impurities of refined sugar, which will startle refiners as well as consumers; the learned gentleman has, however, made *beaucoup de bruit pour peu de besogne*, and has entirely ignored the series of analyses of sugar made both by means of the *saccharimètre optique*, and by very carefully executed and well-devised chemical methods by Professor Mulder, executed some years ago, which proved properly refined sugar, as ordinarily met with in commerce, to be almost chemically pure; and, after all, M. Dubrunfaut does not find anything worse than about 0·01 per cent of glucose, and a very small proportion of ash.

In order to elucidate the history of nitrification, M. Houzeau made a communication in reference to his experiments on the surface soil of Lower Egypt and also of the island of Noirmoutier. His results confirm Lavoisier's opinion, that nitrates are the produce of the slow combustion of certain organic substances placed under favourable circumstances.

M. Fua proposes, in order to prevent the accidents of gas explosions in coal-pits, to place along the roofs thereof platinum wires rolled up in spiral form, and to make these red-hot by means of an electric current, thus ignite cotton wicks previously steeped in molten sulphur, and, moreover, provided with a phosphorus match composition, and to set fire, by this means, to the gas always present in the pits. It need hardly be mentioned that Boussingault very properly observed thereupon that, since the accidents of this kind in coal-pits are chiefly due to sudden outbreaks of gas, and especially to a sudden variation of atmospheric pressure, this plan would not at all answer the purpose, the less so as, according to Combes, a velocity of the gas current, from 2·5 to 3 metres to the second of time, renders the safety lamps also inactive.

M. Koerner communicated that he has succeded in obtaining a base which is isomeric with toluidine, by bringing crystallised monobromated toluol into well-cooled strong nitric acid; he thus first obtains mononitrated bromotoluol, a sulphur-yellow coloured fluid. By treating this fluid first with tin and hydrochloric acid, and the result of this reaction next with sodium-amalgam, the new toluidine is produced; this is a colourless liquid, having about the same specific gravity as water, boiling at 198° C., and yielding, with acids, well-defined salts.

MM. De Laire and Girard made a brief communication concerning the influence of pressure when reactions take place in closed vessels, such as sealed tubes. Among the results obtained by them we notice that increase of pressure does not favour the formation of diphenylamine; that increase of temperature, on the other hand, favours the production of that substance; while increase of pressure paralyses, so to speak, the good influence of temperature.

CORRESPONDENCE.

DISCOVERY OF THE WEIGHT OF THE AIR.

To the Editor of the Chemical News.

Sir,—You will doubtless allow me, through your medium, to reply to Mr. Rodwell. I do so by first giving the text of Aristotle, according to the most authorised editions—viz., those of Berlin, of Didot, and of Du Val in the 17th century, *Imprimerie Royale*:—

Ἐν τῷ αὐτοῦ γὰρ χώρᾳ πάντα βάρος ἔχει πλὴν πυρός, καὶ ὁ ἀήρ.

Σημεῖον δ' ὅτι ἔλκει πλεῖον ὁ πεφυσημένος ἀσκὸς τοῦ κενοῦ.

"Suo enim in loco gravitatem habent omnia præter ignem, etiam ipse aer. Cujus signum est *utrem* inflatum plus ponderis quam vacuum habere."

"Dans son milieu, tout pèse, excepté le feu, y compris l'air lui-même. La preuve en est qu'une outre gonflée pèse plus que si elle etait vide."

"In their own medium, all bodies, except heat, have weight, the proof of which is that a leathern bottle weighs more when filled with air than it does when empty."

Mr. Rodwell has asked for the original text; I give it to him with authorised translations, except, indeed, the English, in which language I have not been able to procure an edition of Aristotle. Besides, the word *ἀσκὸς*, which I find invariably in several editions is sufficient to justify the "*utrem*," which is likewise found in all the Latin translations that I have seen; I might add that it is also the expression "*utrem*" which the majority of Latin commentators make use of.

Ptolemy, Simplicius, Seneca, and Socrates throw no light on this subject.

Ptolemy and Simplicius denied Aristotle's assertion, because they did not admit the theoretical explanation of the philosopher. Seneca might think what he pleased as to the opportuneness of the question; but because he threw jests on it, *en passant*, I do not see how they concern Aristotle. I pass on, then, to another point. Everybody admits that a leathern bottle, whether formed with a skin or consisting of a bladder, constitutes an open extensible vessel, capable, however, of being bent or flattened. Resistance to extension does not, in fact, imply absolute rigidity, and a body can cease to be extended without becoming stiff. It can also be said that a leathern bottle is very slightly extensible, without its meaning rigid. We comprehend, then, that a leathern bottle can receive compressed air; but will it resist any effort made with the intention of bursting it? It would be superfluous to show here that this is a needless fear; prepared skins are not wanting, capable of containing, at least for some length of time, air at a greater pressure than that of the atmosphere; as for the difference in weight necessary to prove it, all depends on the volume of air experimented on. Let us admit the bulk of 15 litres, which is not exorbitant, and suppose that the pressure can be increased in the interior by 15 millimetres; there might be a difference of a gramme, and from thence it would be appreciable. Mr. Rodwell reasons in the persuasion, which he seems to entertain, that Aristotle would have been obliged to swell the bladder with his own breath. But this supposition is unfounded. Long before the philosopher's time, if Homer is to be believed, the Greek smiths were acquainted with the use of bellows; and we read in the "Iliad" that more than twenty bellows were at work in Vulcan's forge for Achilles' shield. Besides, Mr. Rodwell seems to regard it as an undoubted fact that only rough and clumsy scales were in use at the period in which Aristotle lived. This is scarcely the case. If, at this time, gold was weighed with extreme care, why might they not have, I will not say balances indicating the 1-10th of a milligramme, but balances giving the decigramme, if not the centigramme. Mr. Rodwell refers to Aristotle's commentators who repeated his experiment and failed in their attempt. But, as I have said before, many of the philosopher's admirers disregarded his instructions on this point—Ptolemy, Archimides, Thermistius, Simplicius, and a number of others. At the same time, Averroes affirms that he succeeded, and, if I am not mistaken, he is not the only one. If Mr. Rodwell wishes, I will, a little later, point out the text; at the present moment I have not it before me. Why, then, congratulate those who did not succeed, since it is not proved that they and Aristotle must necessarily miscarry in the attempt.

Mr. Rodwell does not think that Aristotle cared much about the honour of passing for a good experimentalist; this astonishes me. Aristotle observed everything with the greatest care, and it is known that he has left little to be said on many branches of natural science, in all that was accessible to him. This is a eulogy which naturalists do not hesitate to accord him—M. Flourens, for instance, to quote only one example, in his refutation of Mr. Darwin's work.

Mr. Rodwell is not an enemy of the philosopher. It is an honour to him to render to this great man the homage of esteem which he deserves. But it is a singular way of proceeding, to contradict, *without certain proofs*, the clear and explicit word of the most exalted genius that human reason, left to its own powers, has produced. Mr. Rodwell's hypothesis does not appear to me demonstrated; and far from being the certain proof, of which I have just spoken, it remains in the state of a supposition.

Finally. My honourable contradictor will find in these lines that the versions of Aristotle which translate *ἀσκὸς* by bladder are not in the right, that there is nothing to prevent the experiment succeeding by means of a leathern bottle; also, that unless something further than what has yet been advanced is proved, it does not remain a less established truth that Aristotle affirmed the fact of the gravity of air, and that he gave, as a proof of it, an experiment which neither disinterested commentators nor actual opponents have proved to be absurd. I cannot, then, understand why Mr. Rodwell has been so eager as he has shown himself in seeking to bring my opinion to nothing. If, in my answer, anything impulsive has escaped me, I disown it, having intended to oppose Mr. Rodwell only, with the greatest esteem for his learning and the greatest courteousness towards him personally.

Such, Sir, is the answer I have thought it right to make to Mr. Rodwell; it will suffice, I hope, to make known my opinion, and to give all needful explanations to my worthy opponent.—I am, &c.,

The Abbe A. Hamy.

Metz, March 16, 1869.

MISCELLANEOUS.

The Chemical Society.—In the report of the discussion on Mr. Chapman's paper, in our last number, Mr. Perkin's remarks were not quite clearly given, we therefore reprint them as follows:—

Mr. Perkin remarked that some time back Mr. Duppa told him that he had succeeded in obtaining the chlorides of the radicals from acetates and salts of other acids by the action of chlorine. In the case of acetates, he obtained chloride of methyl, and from succinates, the chloride of ethylene. He (Mr. Perkin) had made an examination of the chloride of methyl formed in this manner, and found that it produced the ordinary crystalline hydrate, and behaved just like the normal chloride of methyl.

The Royal Society.—Amongst the candidates for admission to the Royal Society this year, we find the names of Henry Dircks, F.C.S.; W. Esson, M.A.; Professor G. C. Foster, B.A., F.C.S.; Peter Le Neve Foster, M.A.;

J. Norman Lockyer; G. Matthey; Dr. Theophilus Redwood, F.C.S.; Cromwell F. Varley; and Dr. A. Voelcker, F.C.S. Altogether forty-five candidates are proposed, out of which fifteen are to be elected in June.

The Chair of Chemistry at Edinburgh.—On Wednesday last, at a meeting of the Curators of the University of Edinburgh, Dr. A. Crum Brown was elected to the Chair of Chemistry, in the room of Dr. Lyon Playfair, M.P., resigned.

Laboratory of the London Institution.—We learn from the *British Medical Journal* that the laboratory of the London Institution is about to be abolished. It is proposed to render the Institution more educational than heretofore; and, with this object in view, a class-room for giving elementary instruction in chemistry is to be substituted for the laboratory of research, which is at present occupied by Professor Wanklyn.

Chemical Prize.—The Chamber of Commerce of Nizza has the intention of awarding a premium of 15,000 francs (£600) to any one who discovers and invents a perfectly reliable and easily executed method of detecting an admixture of oil of grains (rape, linseed, poppyseed, &c.) with olive oil, when more than 5 per cent are present. The process must be such as to be manageable by any one, and not entail difficult or dangerous operations, and, moreover, must be perfectly reliable. The committee of the Chamber of Commerce leave all details to the inventor, but will require him to satisfy them and any scientific or practical men they may wish to consult as to the perfection of the process. Communications to be addressed before the 30th of June next to the President of the Oil of Olives Committee of the Chamber of Commerce of Nizza, Alpes Maritimes, France.—*Ann. de Chim. et Phys., March*, 1869.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Estimation of Carbonates in Water.—(*Zeitschr. f. Anal. Chem.*, 1869.)—Chevalet estimates the entire quantity of carbonates in water by taking 200 c.c., filtering that quantity, and, after adding to it 0·5 gramme of chloride of ammonium, distilling, taking care to collect the first 100 c.c. which come over in 10 c.c. of very dilute sulphuric acid. He next estimates, acidimetrically, the sulphuric acid which has not become combined with ammonia. According to this method he found the solubility of carbonate of lime to be 0·034 gramme, and that of carbonate of magnesia to be 0·106 gramme to the litre of water. These results agree with those obtained by Dr. Hofmann and M. C. Weltzien.

Action of Saline Solutions upon Minerals.—(*Zeitschr. f. Anal. Chem.*, 1869.)—In order to find methods of immediate analysis, Mr. Fevreil has studied the simultaneous action, especially of ammoniacal salts and heat, upon a series of native carbonates. Those of baryta, strontia, and lime are readily and completely acted upon, especially if the acid of the ammoniacal salt experimented with forms in water a readily soluble combination with the carbonate. Native carbonate of magnesia is readily acted upon by all ammoniacal salts; so is also the native carbonate of protoxide of manganese; although less readily, still very unmistakably, carbonate of protoxide of iron is acted upon; with the native carbonates of zinc, lead, and copper, the same was observed.

Atomic Weight of Lanthanum.—(*Zeitschr. f. Anal. Chem.*, 1869.)—Since the determination of the atomic weight of this element has only been derived from the sulphate of baryta obtained from sulphate of lanthanum, and since it has been found that this method is incorrect, in consequence of there being carried down, with the sulphate of baryta, undecomposed sulphate of lanthanum, Dr. W. Casselmann has estimated the correct quantity of sulphuric acid which combines with oxide of lanthanum, by means of ignition. From a long series of several experiments, which agreed, he has deducted the atomic weight of lanthanum to be 45, and that of its oxide 53.

Testing Cinchona Bark.—(*Zeitschr. f. Anal. Chem.*, 1869.)—Twenty grammes of quina regia, or rubra, and 50 grammes of quina fusca are reduced to powder and intimately mixed with one-fourth of their weight of hydrate of lime; this mixture is next placed in ten times its weight of boiling alcohol of 90 per cent strength, filtered, and the residue washed with boiling alcohol. The alcoholic solution is acidified with acetic acid, next the alcohol is removed by distillation, the residue evaporated to dryness on a water-bath, re-dissolved in water containing acetic acid, again filtered, again evaporated to a small bulk, and treated with hydrate of lime. The ensuing precipitate is washed with a small quantity of water, the residue dried, next treated with boiling alcohol, this solution again evaporated to dryness, and the residue weighed. The weight to be obtained from the above-named quantities should not be less, for quina rubra, than ½ of a gramme, for quina regia and fusca not less than ¼ a gramme, provided the barks be of good quality and the operations conducted with proper care.

Action of Air upon Hypophosphorous Acid.—(*Bul. Mén. de la Soc. Chim. de Paris*, 1869, No. 2.)—According to the late G. Rose's views, hypophosphorous acid does not absorb the oxygen from the air, while, according to Würtz, hypophosphites are slowly converted into phosphites. Dr. C. Rammelsberg, in order to settle this point, neutralised some hypophosphorous acid which had been for a long time exposed to air, with carbonate of lime; on testing the salt he thus obtained, he found it gave reactions due to phosphorous acid—consequently hypophosphorous acid changes, by the action of air, into phosphorous acid.

On the Composition of Hydrated Sulphide of Zinc.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—It appears, from different researches, that the hydrated sulphide of zinc does not always possess the same physical properties, and also varies in respect of the water it retains, even after drying. According to recent researches made by M. A. Souchay, the sulphide obtained by precipitating a solution of sulphate of zinc with sulphide of ammonium retains, even after having been kept for several months over sulphuric acid, 11·37 per cent of water, which corresponds to the formula $3ZnS,2HO$; dried at 100° C., it retains 7·35 per cent of water, corresponding approximately with the formula $2ZnS,HO$; dried at 150° C., it retains 4·86 per cent of water—formula, $5ZnS,HO$.

Preparation of Spongy Oxide of Chromium.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—Böttger recommends, for this purpose, to set fire to a mixture of 1 part of picric acid and 2 parts of bichromate of ammonia.

Preparation of Perfectly Pure Oxygen Gas.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—Böttger recommends, for this purpose, to heat permanganate of potash; it is true that this salt only yields about 10 per cent of oxygen, but it is perfectly free from chlorine, as well as from ozone. There remains, as residue, a mixture of manganate of potash and oxide of manganese, readily re-convertible into permanganate.

Action of Heat on Sulphate of Strontia.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—M. Darmstadt calls attention to the fact that sulphate of strontia obtained by double decomposition loses sulphuric acid when it is strongly ignited; moistened again with dilute sulphuric acid, it regains its primitive weight after ignition over a Bunsen burner. Boussingault proved years ago that all the sulphates of the alkaline earths lose sulphuric acid when strongly ignited.

On the Preparation of Zinc-Ethyl.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—M. H. Wichelhaus has found that the coarsely-powdered zinc, obtained by passing zinc filings through a sieve, acts directly upon the iodide of ethyl, without the necessity of having the zinc alloyed with sodium. The reaction readily takes place when the apparatus containing the mixture is placed in a water-bath; the apparatus should be provided with a tube containing mercury, in order to increase the pressure; the reaction is finished in two or three hours. The result is satisfactory, and yields from 80 to 90 per cent of the theoretically-required quantity.

Composition of Sugar-Scum.—(*Bul. Men. de la Soc. Chim. de Paris*, 1869, No. 2.)—This material, which is used as manure, is obtained in that portion of the sugar refining and sugar extraction process called *defecation*. The results of the analysis here quoted are given by M. Roussille:—Organic matter, 33·51; carbonic acid, 10·37; silica and soluble silicates, 3·42; soluble silica, 0·90; oxide of iron and alumina, 1·37; phosphoric acid, 0·46; lime, 41·40; potassa and soda, 0·04; chlorine, 0·02; sulphuric acid, 0·03; water, 7·27; loss, 1·21; total, 100·00; nitrogen, 0·446. It is almost unnecessary to observe that the composition of this material will of necessity vary in many aspects.

Researches Concerning Balsamic Modena Vinegar.—(*Bul. de la Soc. Chim.*, 1869, No. 2.)—Fausto Sestini has made some researches concerning this substance, very little, if at all known, or used, in more recent times; all the samples, five in number, submitted to analysis were more than 100 years old. The fluids are dark-coloured, exhibit an aromatic odour, possess a pleasant acid taste, are rather thickish, syrup-like, but miscible with water without becoming turbid; mixed with alcohol, however, a dark-coloured precipitate ensues. The specific gravity of these fluids varied from 1·1931 to 1·3177; the quantity of water from 42·647 to 62·270 per cent; the quantity of monohydrated acetic acid from 7·051 to 10·011 per cent: fixed acid was present at from 0·767 to 1·925 per cent; ulmin-like matter was found at from 2·072 to 5·531; other fixed non-volatile organic matter occurred at from 18·464 to 44·447 per cent; ash, at from 0·952 to 1·290 per cent. It is rather curious, that, among the substances found by the author in these fluids, glucic and apoglucic acids have been met with.

Readily Inflammable Liquid Mixture.—(*Cosmos*, April 10, 1869.)—Professor Nicklès calls attention to the fact, that when the chloride of sulphur of commerce is mixed with sulphide of carbon wherein phosphorus has been previously dissolved, a fluid is formed, which, though emitting fumes when in contact with air, is harmless, and may be for any length of time kept in well-stoppered bottles; on addition of liquid ammonia, however, or on passing into this liquid a few bubbles of ammonia gas, a most intense combustion at once ensues. This is due to the fact that the ammonia seizes upon the chloride of sulphur, forming chloride of ammonium, whereby so much heat is set free as to cause the combustion of the sulphide of carbon and phosphorus dissolved in it.

On some Molecular Combinations of Phenol.—(*Bul. de la Soc. Chim.*, 1869, No. 2.)—Professor J. Romei has repeated some experiments suggested to his mind by some made by Dr. C. Calvert on this same subject, in order to test whether Gerhardt's view of phenol, or that of the former gentleman, were correct; the question being whether the combinations of phenol with bases are true salts, or simply molecular juxtapositions of matter. Professor Romei has concluded, from his experiments, that Dr. Calvert's view is correct—that is to say, that the combinations of phenol with bases is a simple molecular juxtaposition, and not an atomic compound. Phenate of potassa may be made either by mixing together alcoholic solutions of phenol and hydrate of potassa, and evaporating until crystals are formed, or by fusing together phenol and potassa; in both instances a crystalline mass is obtained which absorbs moisture from the air, becomes gradually yellow and lastly brown, is soluble in water and alcohol, somewhat soluble in ether containing water, but almost entirely insoluble in anhydrous ether. As average result of four analyses, the following figures were obtained for 100 parts:—Phenol, 56·60; hydrated potassa, 31·30; water, 12·00—this is represented by the formula, C_6H_6O,KHO. Phenate of oxide of copper is obtained by double decomposition, by pouring a solution of sulphate of copper into a solution of phenate of potassa. The phenate thus obtained is dried over sulphuric acid; it is a green powder, soluble in acids and readily decomposed by heat; its composition is exhibited by—

$$2(C_6H_6O),3(CuOH_2O_2).$$

It contains 55·88 per cent of oxide of copper; the water of combination cannot be removed by heat, or otherwise, without decomposing the salt. Phenate of oxide of mercury, also obtained by double decomposition and drying over sulphuric acid, yields a compound containing 69·33 per cent of oxide of mercury—formula, C_6H_6O,HgO_2H_2. Phenate of quinine is prepared, by double decomposition, from 3·72 parts of sulphate of quinine and 3 parts of phenate of potassa, both in alcoholic solution. After twenty-four hours' standing, the sulphate of potassa is removed by filtration, and the filtrate evaporated at a very gentle heat; very beautiful crystals are obtained nearly insoluble in ether, very soluble in alcohol and acids, but insoluble in water. On analysis, this substance yielded 76·69 per cent of quinine, while the theory requires 77·51. The author calls attention to the fact that phenate of potassa may very usefully serve for the detection of water in ether; the salt is entirely insoluble in pure and anhydrous ether, but as soon as any water is present therein, partial solution takes place, even if the ether contained only 2·50 parts of water in 1000 of ether.

On Cinnamate of Benzyl.—(*Bul. de la Soc. Chim. de Paris*, 1869, No. 2.—From Peru balsam Frémy has obtained an oily substance named cinnameine; this material yields, when saponified, cinnamic acid. When chloride of benzyl and thoroughly dry cinnamate of soda are mixed and boiled along with alcohol, cinnamate of benzyl is formed; this substance, represented by $C_{18}H_{14}O_2$, is obtained in small pearly, scaly crystals. It melts at 39° C., and may remain in a semi-fluid state, even at a temperature close upon 0° C.; it distils over, unchanged, in a space from which air is exhausted at between 225° and 235°; becomes decomposed at 350°, yielding cinnamic acid and oily substances. It is very soluble in alcohol and ether; when deposited after the evaporation of that solvent, it exhibits oily drops, which slowly solidify. It is decomposed by an alcoholic solution of potassa.

On the Cause of the Hardening of Hydraulic Cement.—(*Zeitschr. f. Chem.*)—In order to test the truth of the different hypotheses made concerning this subject, A. Schulatschenko, seeing the impossibility of separating, from a mixture of silicates, each special combination thereof, repeated Fuchs's experiment, by separating the silica from 100 parts of pure soluble silicate of potassa, and, after mixing it with fifty parts of lime, and placing the mass under water, when it hardened rapidly. A similar mixture was submitted to a very high temperature, and in this case, also, a cement was made. As a third experiment, a similar mixture was heated till it was fused; after having been cooled and pulverised, the fused mass did not harden any more under water. Hence it follows that hardening does take place in cement made by the wet as well as dry process, and that the so-called over-burned cement is inactive, in consequence of its particles having suffered a physical change.

Frangulin.—(*Zeitschr. f. Chem.*, 1869, No. 1.)—The substance which, many years ago, was named rhamnoxanlin by Buchner, is obtained from the bark of the *Rhamnus frangula*, a tree growing wild in Southern Europe, by boiling it with ammoniacal water, precipitating with hydrochloric acid, and boiling the precipitate with alcohol and acetate of lead. Frangulin, $C_{20}H_{20}O_{10}$, exhibits a yellow mass having a distinctly crystalline texture, as may be seen with a lens, almost insoluble in cold water, slightly soluble in cold alcohol, and more soluble in boiling alcohol, soluble in alkaline solutions, and then exhibiting a most brilliant purplish-red colour. Its ammonia solution is at first colourless, and becomes, after a while, a brilliant red; it fuses at 226° C., and is a very weak acid. Acids split this substance into sugar and frangulinic acid—

$$C_{20}H_{20}O_{10}+H_2O=C_{14}H_{10}O_5+C_6H_{12}O_6.$$

Detection of Sulphurous and Hyposulphurous Acid.—(*Zeitschr. f. Chem.*, 1869, No. 1.)—Instead of employing hydrochloric acid and zinc, Reichardt uses aluminium and hydrochloric acid. Zinc may be contaminated with sulphur compounds, while aluminium, on account of its having almost no affinity for sulphur, is always pure in this respect; the latter metal, moreover, dissolves very slowly in dilute hydrochloric acid, and therefore the same piece of aluminium may serve for many testings. Reichardt distinctly detected the sulphuretted hydrogen when a solution of one part of SO_2 in water, diluted with 500,000 parts of water, was treated with HCl and aluminium.

On Pyruvic Acid.—(*Bul. de la Soc. Chim. de Paris*, 1869, No. 2.)—MM. Ph. de Clermont and R. Silva state that they have been engaged for some time in researches on this acid, but that the results obtained are not sufficiently far advanced to enable them to speak with exactitude as to its real composition. Purified pyruvic acid, treated by bromine, becomes a crystalline mass, which was found to be bibromo-lactic acid; this acid, treated with water and evaporated in vacuo, yields a crystalline mass—another acid—the nature of which has not yet been further investigated.

Observations on the Preparation of Strong Hydriodic Acid in Solution.—(*Bul. de la Soc. Chim. de Paris*, 1869, No. 2.)—Since this acid is becoming daily more and more used, Mr. Ferd. Vigier has studied the best mode of its preparation. It is well known that, for this purpose, a mixture of amorphous phosphorus (as first suggested by M. Personne), iodine, and water is gently heated in a tubulated retort to the beak of which a glass tube has been soldered. Vigier has found that too often, in text- and hand-books on Chemistry, a wrong proportion of the ingredients to be used is given; and after some experiments on this subject, he finds that 1 part of phosphorus, 20 parts of iodine, and 15 of water, are the best and only proper to ensure the reaction taking place; these proportions correspond to the formula, $P+5I+5HO=PO_5+5HI$.

Constitution of Phenaconic Acid, and the Transformation of Benzol into Tartaric Acid.—By L. Carius.—(*Ann. d. Chem. u. Pharm.*, vol. clix., No. 3, March, 1869.)—In a former paper, the author described two substances—trichlorophenomalic acid and phenaconic acid; the former of these is the direct product of the action of hydrate of chloric acid upon benzol, according to the formula—

$$C_6H_6+(ClHO_3)_2=\underbrace{C_6H_7Cl_3O_6}_{\text{Trichlorophenomalic acid.}}+OH_2;$$

the latter combination, however, is the result of the action of metallic oxides upon the acid just alluded to. Phenaconic acid is a tribasic acid, which may be considered as tricarbonic acid—

$$(CO)_3C_8H_8.O_2.H_2.$$

The author describes at great length a series of very complex combinations and reactions obtained by him while studying this acid and submitting it to divers chemical agents, and finally arrives at the result that tartaric acid may be obtained from phenaconic acid, and hence, derivatively, from benzol by the intermediate of dibromo-succinic acid.

NOTES ON LECTURE EXPERIMENTS.

Sudden Crystallisation.—I am obliged to Mr. Allen for his note respecting crystallisation, but am sorry it does not give me any information about my difficulty with respect to breakage of the flask. I have avoided the use of thick vessels in consequence of their liability to crack in preparing the supersaturated solution; and I am at a loss to understand how Mr. Allen prepares his solution in a medicine bottle. Would he kindly inform me?—CRYSTAL.

NOTES AND QUERIES.

Dutch Liquid.—Can any one please inform me of a cheap and continuous process of making quantities of Dutch liquid or olefiant gas?—JAMES LISTER.

Sand-Storm.—The *Moniteur Belge* of April 9th, mentions that at Naples, Messina, and the whole of Southern Italy, daylight, during the day of March 24th, was so obscured by the sand of the African deserts, that at Reggio and many other places lamp-light had to be resorted to as a means of enabling people to perform their daily work; the sand was carried by the south wind even as far as Turin. Professor Palmieri recognised the true nature of this sand by means of the microscope.

Action of Ammonia on Phosphorus.—Some very interesting and curious experiments on the action of ammonia on phosphorus have been published by M. Blondlot. When a piece of phosphorus is kept in strong liquid ammonia, it becomes first brownish, then green, and finally deep black. At the same time that these changes of colour occur, the phosphorus becomes hard and brittle; it cracks and splits, and ultimately falls to powder. Solar light favours this change remarkably, causing it to become manifest in several days, while in dark, more than a year is required for its accomplishment. The most concentrated ammonia produces the most rapid and decided change. The black phosphorus may be easily rubbed down to fine powder in a mortar with some water; it may then be dried on a water bath. If it retains any unchanged phosphorus which would cause its ignition, this may be removed by washing with sulphide of carbon. Passed through a fine sieve it constitutes an intensely black impalpable powder, which may be preserved under water without sensible alteration, but if exposed dry to air it slowly evolves a trace of ammonia, and, little by little, becomes yellow. In this state it resembles amorphous phosphorus in several of its chemical characters, although in some others it differs considerably, and notably in colour. The yellow powder heated in a tube to 200° C. evolves some phosphuretted hydrogen, and passes to ordinary amorphous phosphorus; treated with ammonia, it re-assumes in the course of an hour its original black colour. Although Blondlot has not accurately determined the chemical nature of these changes, he is inclined to regard the powder as containing solid hydride of phosphorus and hydrated amorphous phosphorus.—*Pharmaceutical Journal.*

Decomposition Cell for the Oxy-Hydrogen Lantern.—A simple and convenient arrangement may be made as follows:—take two square pieces of plate glass, and also two square pieces of vulcanised india rubber, all of the same size. Cut the rubber so as to form two pieces, each of the shape ⊔. Two platinum wires, serving as electrodes, are then placed between the two pieces of rubber, the glass plates placed one on each side of the rubber frames, and the whole fastened together by clamps at the edge. The cell I have made is 2 inches square, and the rubber ¼ of an inch thick.—C. J. Woodward, Midland Institute, April 13th, 1869.

New Mixture for Tempering Steel.—A locksmith at Mulhouse, named Herrenschmidt, claims to have discovered a mixture which is said to give to the commonest steel the grain and temper of the finest cast metal, and, moreover, to have the power of bringing back the original quality of steel which has been burnt. The mixture is composed as follows:—With 16 litres of distilled water mix 1 kilogramme of hydrochloric acid, 19 grms. of nitric acid (sp. gr. 1·334), 21 grms. of sulphate of zinc, and 100 grms. of tripoli. In this mixture is to be placed a piece of cast-iron of the first fusion, weighing 100 grms. When the acid mixture has acted for twenty-four hours, the composition is ready for use in the ordinary way, which, in all likelihood, means for cooling therein previously heated steel, and the composition remains effective till it is all used.—*Mining Journal.*

Detection of Diamonds.—Several of your contemporaries quote what they call a safe and easy, but after all a clumsy, method of testing the true nature of diamond, by burying it in powdered fluor spar, placed in a platinum crucible, pouring strong sulphuric acid over it, and exposing the crucible to heat on hot charcoal, with the precaution to be attended to, not to breathe the fumes. It need hardly be mentioned that since fluid hydrofluoric acid is sold in gutta-percha-made bottles, and whereas the acid thus sold is sufficiently concentrated strongly to attack any glass, even that called *strass*, generally used to imitate diamonds, there is no need whatever for performing an experiment as described, which in inexperienced hands may become dangerous. The liquid acid alluded to is quite efficient enough to test diamonds, if it is required to do so, by this means; the fluid sold also attacks native quartz.—Q.

MEETINGS FOR THE WEEK.

Monday, 19th.—Medical, 8.
Tuesday, 20th.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."
Wednesday, 21st.—Meteorological, 7.
Thursday, 22nd.—Royal Institution, 3. Professor Tyndall, "On Light."
—— Royal, 8.30.
—— London Institution, 6.
—— Zoological, 8.30.
—— Royal Society Club, 6.
Friday, 23rd.—Royal Institution, 8. E. B. Tylor, Esq., "On the Survival of Savage Thought in Modern Civilsation."
—— Quekett Microscopical Club, 8.
Saturday, 17th.—Royal Institution, 3. A. Geikie, Esq., "On the Origin of Land Surfaces."

TO CORRESPONDENTS.

Communications have been received from H. Natham; T. Hill; W. Perkin, F.R.S.; H. C. Sorby, F.R.S.; J. Lister; C. H. Osborne; A. G. Pritchard; E. T. Chapman; E. A. Erlandson; F. W. Hart; J. Spiller; D. Jefferson; H. Rich; H. Sewill; Dr. R. A. Smith, F.R.S.; T. C. Ansdell; D. Brown; R. E. Branston; J. B. Ledshaw; Dr. Röhrig; A. H. Allen (with enclosure); E. Bloom (with enclosure); S. W. Rich; B. Leeson; E. G. Tosh; Dr. Balfour Stewart; The Magnesium Metal Co. (with enclosure); and J. Heywood.

BOOKS RECEIVED.

Chemical Labels according to the latest system of Nomenclature. Compiled by H. Matthews, F.C.S., and C. W Quin. London: H. K. Lewis.
Pocket Guide to the British Pharmacopœia.
The Hospital Pharmacopœias of London. By Peter Squire, F.L.S., &c. Second Edition. London: John Churchill and Sons.
Lessons in Elementary Chemistry, Inorganic and Organic. By Henry E. Roscoe, B.A., F.R.S. New Edition. London: Macmillan and Co.

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On English and Foreign Alkalimetrical and Chlorimetrical Degrees, by John Pattinson, F.C.S. Read before the Newcastle Chemical Society.

London: Chemical News Office, Boy Court, Ludgate Hill, E.C.

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THE CHEMICAL NEWS.

VOL. XIX. No. 490.

ON THE CHEMICAL FORMULA OF ALIZARINE.

By EDWARD SCHUNCK, Ph.D., F.R.S., &c.

THE discovery of a mode of preparing alizarine artificially, lately made by MM. Graebe and Liebermann, and brought before the notice of the Society at its last meeting by Professor Roscoe, is not only of the highest importance from a practical point of view, but is also of great interest as being the first recorded instance of the artificial formation of a natural colouring matter. The formula to which I was led in my examination of the colouring matters of madder, viz., $C_{14}H_{10}O_4$, approaches very closely, as Professor Roscoe observed, to the one now adopted by Graebe and Liebermann, $C_{14}H_8O_4$. My formula was not founded on theoretical views but simply expressed the composition to which my numerous analyses of alizarine and its compounds conducted. I have until now seen no reason whatever to adopt any other, notwithstanding that Strecker's formula, $C_{10}H_6O_3$ has been preferred by most chemists, and was even pronounced by Laurent to be the only one possible. That my analyses do not in the least correspond with the latter formula, but are not inconsistent with that of Graebe and Liebermann, will be seen by a glance at the following numerical results of some analyses of alizarine from various sources:—

	I.	II.	III.	IV.	V.	Mean.
C	69·15	69·37	69·59	69·66	69·73	69·50
H	4·04	4·07	4·26	4·00	3·71	4·01
O	26·81	26·56	26·15	26·34	26·56	26·49

Of these analyses, I. was made with material obtained directly from madder, II. and III. with specimens derived from rubian by decomposition with acid and with ferment, IV. with alizarine from rubianic acid (its glucoside), and V. with sublimed alizarine. The three formulæ, $C_{14}H_8O_4$, $C_{14}H_{10}O_4$, and $C_{10}H_6O_3$, require the following percentages of C, H, and O.

	$C_{14}H_8O_4$.	$C_{14}H_{10}O_4$.	$C_{10}H_6O_3$.
C	70·00	69·42	68·96
H	3·33	4·13	3·45
O	26·67	26·45	27·59

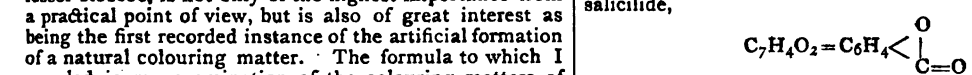
It will be seen that my results are not reconcilable with the last formula, whereas in some cases, especially in that of sublimed alizarine, the composition found agrees tolerably well with the new formula, $C_{14}H_8O_4$. The great excess of hydrogen found even in the case of well crystallised and apparently quite pure alizarine remains to be explained, and though unwilling to throw any doubt on the complete identity of the natural and artificial product, I confess I look forward with great interest to the full confirmation of this remarkable discovery.

ON THE CONSTITUTION OF COUMARIN AND COUMARIC ACID.

By Prof. RUDOLPH FITTIG.

AT the meeting of the Chemical Society, held April 1st, Mr. Perkin stated that my views on the constitution of coumarin could not be correct, inasmuch as coumarin has not the properties of an anhydride. I cannot consider the objections either of Mr. Perkin or of Prof. Williamson as conclusive. Coumarin certainly conducts itself in an entirely different manner from lactide and other anhydrides of the fatty series; but it does not belong to this series; on the contrary, it is a derivative of benzol. The formula proposed by me (CHEMICAL NEWS, vol. xix., p. 3)—

shows that one of the oxygen atoms unites the third atom of carbon of the chain CH=CH—CO with the benzol residue, C_6H_4. A chain of this sort, just as all aromatic compounds, must be much more stable than similar bodies of the fatty group. But the properties of the fatty anhydrides also are not the same, the one is much more stable than the other. Acetic anhydride is suddenly decomposed by water and alcohol, succinic anhydride is not attacked by cold water, and lactide can be recrystallised from hot alcohol without decomposition. We are furthermore acquainted with an aromatic body of similar constitution, salicilide,



obtained by Gerhardt from salicylate of sodium and oxychloride of phosphorus, which shows, although not the same, still a stability very similar to that of coumarin. Boiling with water and carbonate of sodium produces no effect upon it. Ammonia acts upon it even at the boiling temperature extremely slowly. Heating with caustic potassa converts it into salicylic acid. Coumarin conducts itself in the same way. It is converted into coumaric acid even at 40—60° C., through the influence of dilute alkalies, as has been proved by Zwenger. Perkin says, "it was not an easy matter to produce coumaric acid from coumarin." This arises apparently from the fact that he used too concentrated solutions of potassa, which makes coumarin more stable, as Zwenger has already observed (*Ann. Chem. Pharm.*, Suppl., 5, 122).

The fact that coumarin occurs in plants in presence of water—in most cases together with coumaric acid (Zwenger)—can so much the less be regarded as proof, as other anhydrides occur in nature. Many resins are, as is known, such anhydrides of acids.

Concerning the negative results of Mr. Perkin in the repetition of Bertagnini's experiment on the artificial formation of cinnamic acid from the oil of bitter almonds and chloride of acetyl, I will merely mention that Kraut (*Ann. Chem. Pharm.*, 147, 111) has also repeated this experiment, and has found that the acid obtained in this way is in every respect identical with cinnamic acid. I will also add, that a short time ago, one of my pupils, Mr. Bieber, by means of the same reaction, from oil of bitter almonds and chloride of butyryle, at 130° C., prepared an acid, $C_{11}H_{12}O_2 = C_6H_5.C_4H_6.COHO$ (phenyl-angelica-acid), which is homologous with cinnamic acid, and very similar to it. It melts at 81°, is difficultly soluble in water, and gives a barium and calcium salt, which are also somewhat difficultly soluble in cold water.

Göttingen, April 16, 1869.

VEGETABLE ELECTROMOTORS.

By EDWIN SMITH, M.A.

IT is well known that a voltaic combination may be made of two liquids and a metal, if one of the three acts chemically upon one, and only one, of the other two; thus—we may employ copper, nitrate of copper, and dilute nitric acid; or platinum, potash, and nitric acid. Connect a platinum crucible with one terminal of a galvanometer, pour in a little solution of caustic potash, place in this the bowl of a tobacco-pipe having the hole stopped up with wax, pour into the bowl a little nitric acid, dip in the acid a small slip of platinum foil, and connect this with the other terminal of the galvanometer; a powerful deflection of the needle indicates the presence of an electric current, and shows its direction to be from

the alkali to the acid, the platinum serving merely as a conductor. It occurred to me, when performing this experiment, that an electro-motive combination might just as well be made of two vegetable substances, with platinum for conductor, provided only they were of a nature to act chemically upon one another—an alkaloid and an organic acid, for instance. It also seemed to me not unlikely that, wherever two flavours are habitually conjoined in our cookery and eating, the reason why they mutually improve each other is because a certain amount of electric action is set up between the substances employed to produce them. The *rationale* of the right blending of flavours might be found partly, no doubt, in chemistry, but partly, also, in galvanism.

Pursuing this idea, I tried pairs of eatables which generally go together, such as pepper and salt, coffee and sugar, almonds and raisins, and the like, and found that a voltaic current more or less strong was excited in every instance which I tested. Bitters and sweets, pungents and salts, or bitters and acids, generally appear to furnish true voltaic couples, doubtless in consequence of the mutual action of some alkaloid salt and an acid or its equivalent. As others may like to repeat or extend the experiments, I will describe shortly my mode of procedure:—Cut two pieces of platinum foil about 5 in. by 2½ in., and a number of pieces of filter-paper a trifle larger. Well-washed linen is sometimes more convenient than filter-paper. Have a small wooden board near the mercury cups of the galvanometer, and let a short copper or platinum wire, dipping into one of the cups, rest on the board. The substances to be tried must be brought to a state of solution, the stronger the better, by infusion, decoction, or otherwise. Suppose coffee and sugar are to be operated upon; solutions of both having been prepared, dip into each a slip of filter-paper; place one slip on one of the pieces of platinum foil, and the other on the second piece. Next lay the first slip and its foil on the board, with the metal touching the copper wire before mentioned. Lay the second slip with its platinum upwards, so that the coffee and sugar come into even contact with slight pressure, and immediately connect this upper slip, through a bit of copper wire, insulated from the touch, with the other terminal of the galvanometer. Deflection occurs instantaneously, and may be increased to a considerable vibration by breaking and making circuit at the right swing of the needle. After a few distinct vibrations, it is well to turn over the whole pile of slips just as they are, and connect opposite ends with the galvanometer, so as to reverse the current. This is desirable for the sake of confirming your previous observation, and of correcting any slight disturbing cause arising from the wire and mercury connectors, temperature of the hand, and so forth. It will be found that coffee and sugar have the same electrical relation to each other as zinc and platinum. Coffee, in fact, is the positive, sugar the negative element. I subjoin a table of the results of numerous experiments, conducted in the manner above described.

ELECTRO-POSITIVE.	ELECTRO-NEGATIVE.
Coffee	Sugar (loaf).
Tea (black)	"
Cocoa	"
Nutmeg	"
Cloves	"
Cinnamon	"
Mace	"
Vanilla	"
Almonds	"
Rhubarb (tincture)	"
Starch	"
Starch caramel	"
Gum caramel	"
Cane sugar caramel	"
Milk sugar	"
Gum	"
Almonds	Raisins.
Horseradish	Beetroot.
Onion	"
Horseradish	Table salt.
Mustard	"
Pepper (white)	"
Mustard	Tartaric Acid.
Ginger	Tartaric Acid.
Cayenne pepper	" "
Pepper (white)	" "
Tea (black)	" "
Tobacco	" "
Quinine (Howard's)	" "
Gentian root	" "
Lemon juice	" "
Horehound	" "
Lavender water	" "
Quassia	" "
Peppermint	" "
Raw potato	Lemon juice.
Rind of lemon	"
Peruvian bark	"
Camphor (tincture)	"
Laudanum	"
Arnica (tincture)	Dilute Sulphuric Acid.
Peruvian bark	" "
Quinine (Howard's)	" "
Iodine (tincture)	Turpentine.
Caustic potash	"
Starch	"
Starch	Iodine (tincture).
Caustic potash	Neat's-foot oil.

It is somewhat difficult to eliminate from these experiments all error arising from difference of temperature, if the galvanometer is tolerably sensitive. Care must be taken to bring the pair of solutions operated upon to the same temperature before testing them; otherwise a thermo-electric current from the hotter to the colder liquid may affect the needle, and mask the true electrical relation between the two, so far as it depends upon their chemical nature.

ON THE DERIVATIVES OF PROPANE (HYDRIDE OF PROPYL).*

By C. SCHORLEMMER.

AT the time when I commenced this investigation, the existence of normal propyl alcohol was very doubtful. According to Chancel†, this body is found in the fusel oil from the marc of grapes, but Mendelegeff‡ tried in vain to isolate it from a sample of this oil which he had obtained from Chancel himself. Several attempts to prepare the normal alcohol by synthesis failed. Thus Linnemann and Siersch‖ tried to obtain it by converting acetonitril into propylamine, by means of hydrogen in the nascent state, and decomposing the hydrochlorate of this base with silver nitrite, but the alcohol thus formed was found to be the secondary one. The same compound was obtained by Butlerow and Ossokin§, by acting upon ethylene iodohydrine,

$$C_2H_4\left\{\begin{matrix}OH\\I\end{matrix}\right.$$

with zinc methyl, in order to replace iodine by methyl. Now as in both cases, according to theory, the normal or primary alcohol ought to have been formed, and as we have no explanation why instead of this compound the secondary alcohol was obtained, Butlerow and Ossokin believe that the normal propyl alcohol cannot exist. Not agreeing with this view, I was led to an investigation of this subject, the results of which I have the honour to lay before the Society.

My reasoning was as follows:—It appears, as the most probable theory, and which is now accepted by most chemists, that the four combining powers of the carbon atom have the same value. If so, only one hydrocarbon having the composition C_3H_8 can exist. This *propane* must be formed by replacing in the secondary propyl iodide, the iodine by hydrogen, and subjecting the hydrocarbon thus obtained to the action of chlorine, by which primary propyl chloride must be formed in accordance with the behaviour of other hydrocarbons of the same series.

* Read before the Royal Society, April 8th, 1869.
† *Comptes Rendus*, vol. xxxvii., p. 410.
‡ *Zeitschrift für Chemie*, 1868, p. 25.
‖ *Annalen Chem. Pharm.*, vol. cxliv., p. 237.
§ *Annalen Chem. Pharm.*, vol. cxlv., p. 257.

I soon found that my theory was correct; and in a short note, which I published in *Zeitschrift für Chemie* (1868, p. 49), I stated that I had obtained the normal propyl alcohol by this method. At the same time, Fittig proved that it was contained in fusel-oils,* and lately, Linneman prepared it synthetically from ethyl-compounds by converting acetonitrile (ethyl cyanide) into propionic anhydride, and acting upon this body with nascent hydrogen†.

The propane which I used in my researches was obtained by acting upon isopropyl iodide with zinc turnings and diluted hydrochloric acid. A continuous evolution of gas takes place if the flask containing the mixture is kept cold. If it is not cooled down a violent reaction soon sets in. The gas always contains vapour of the iodide, even if it has been evolved very slowly. In order to purify it as much as possible, it was washed with Nordhausen sulphuric acid, with a mixture of nitric and sulphuric acids, and with caustic soda solution.

As a gas-holder I used a tubulated bell-jar, which was suspended in a larger inverted one, filled with a concentrated solution of common salt. When a sufficient quantity of gas had collected, chlorine was passed into it, care being taken not to have it in excess. In diffused daylight substitution products were formed, which collected as an oily layer on the salt solution. Alternately more propane and chlorine were passed into the apparatus, until it was nearly filled with the excess of propane and vapours of the most volatile substitution products. The latter were condensed by passing the gas into a receiver surrounded by a freezing mixture. To collect the liquid chlorides which were contained in the gas-holder, the tubulus of the bell-jar was closed with cork, which was provided with a wide short glass tube, open at both ends, and so much salt solution put into the gas-holder that the chlorides entered this tube, from which they could easily be removed with a pipette. By repeating this process several times, a quantity of chlorine compounds, sufficient for further investigation, was obtained. This was washed with water, dried over caustic potash, and distilled. The liquid commenced to boil at 42° C., the boiling-point rising towards the end above 200° C. By fractional distillation, a comparatively small quantity of liquid was obtained, which boiled at 42°—46°, and consisted of the primary propyl chloride, C_3H_7Cl.

0·0975 of this chloride gave 0·1730 silver chloride, and 0·005 silver, corresponding to 0·044 chlorine.

Calculated for C_3H_7Cl.	Found.
45·2 per cent Cl.	45·5 per cent Cl.

In order to prove that this body was really the normal chloride, it had to be converted into the alcohol. For this purpose I used that portion of the chlorides which, after repeated distillation, boiled below 80° C. It was heated in sealed tubes with potassium acetate and glacial acetic acid for several hours to 200° C., and thus converted into the acetate, a light colourless liquid, possessing the characteristic odour of the acetic ethers. I did not endeavour to obtain this ether in the pure state, as this could have been only effected with great loss of material, but converted it at once into the alcohol, by heating it with a diluted solution of potash, in sealed tubes, up to 120° C. After cooling, the contents of the tubes were distilled and rectified. A portion of it was oxidised with a cold dilute solution of chromic acid. No gas was evolved, but a strong smell of aldehyd was perceived, which disappeared on adding more chromic acid. On distilling to dryness, an acid liquid was obtained, which was neutralised with sodium carbonate. The solution was evaporated to dryness, and the residue distilled with a quantity of sulphuric acid, sufficient to liberate about one-fourth of the acid. The residue in the retort was again distilled with the same quantity of sulphuric acid, and, by repeating this process, the acid was obtained in four fractions. Each of these was converted into the silver salt by boiling with silver carbonate. The silver salts crystallised from the hot saturated solution in small shining needles, which were grouped in stars and feathers. These were dried, first over sulphuric acid, afterwards in the steam-bath, and the silver determined by ignition.

				per cent.
Fraction (1)	0·2350 gave	0·1404	silver	= 59·74
,, (2)	0·2420 ,,	0·1450	,,	= 59·91
,, (3)	0·1676 ,,	0·1002	,,	= 59·78
,, (4)	0·2124 ,,	0·1264	,,	= 59·51
			Mean	59·73
			Silver propionate contains	59·67

I also prepared the lead-salt, which exhibited the properties of lead-propionate; it did not crystallise, but dried up to an amorphous gum-like mass. As by oxidation no other acid besides propionic was found, it follows that the alcoholic liquid could only contain normal propyl alcohol. I tried to isolate this body from the remaining liquid, by adding potassium carbonate until it separated into two layers. The upper one was taken off and dried, first over fused potassium carbonate, and afterwards over anhydrous baryta. This liquid, however, proved to be a mixture; it began to boil at 80° C., and the boiling-point rose slowly to 96° C. By fractionating, it could be separated into two portions—a smaller one boiling between 80° and 85°, and a larger one boiling above 90°. The portion boiling between 92° and 96° gave, by combustion, numbers agreeing with the composition of propyl alcohol.

0·2238 substance gave 0·4098 carbon dioxide, and 0·2675 water.

	Calculated.		Found.
C_3	36	60·00	59·81
H_8	8	13·33	13·28
O	16	26·67	—
	60	100·00	

I have not yet studied the properties of this alcohol, as I hope to obtain it soon in larger quantities.

The liquid boiling between 80° and 85° appears to be an acetal; it is not acted upon by sodium, and therefore can easily be obtained free from alcohol, by distilling it over this metal. The small quantity was just sufficient for two analyses, the results of which give $C_5H_{12}O_2$ as the probable formula.

(1) 0·2500 gave 0·2725 water, and 0·5280 carbon dioxide.
(2) 0·2755 gave 0·2950 water; the determination of carbon was lost.

	Calculated.		Found. I.	Found. II.
C_5	60	57·96	57·60	—
H_{12}	12	11·53	12·11	11·93
O_2	32	30·78	—	—
	104	100·00		

How this body has been formed I cannot explain.

As I have already mentioned, chloride of propyl forms only a small fraction of the products obtained by subjecting propane to the action of chlorine, the chief product of the reaction being a liquid which boils at 94° to 98° C., and has the formula $C_3H_6Cl_2$.

0·1600 gave 0·3970 silver chloride, and 0·005 silver.

Calculated for $C_3H_6Cl_2$.	Found.
62·8 per cent Cl.	62·4 per cent.

This body is propylene dichloride; for its boiling point not only coincides with that of this compound, but also all its reactions are the same. Heated with potassium acetate, and acetic acid in closed tubes, it is readily decomposed, a high boiling acetate being formed, which, on heating with concentrated potash solution and distilling, yields a liquid, the last portion of which boils between 180° and 190° C., and possesses the sweet taste of propyl glycol. I did not isolate the glycol in the pure state, but proposed to establish its structure by oxidation.

A diluted cold solution of chromic acid acts violently

* *Zeitschrift f. Chemie*, 1868. p. 44.
† *Annalen Chem. Pharm.* vol. cxlviii., p. 251.

on it, carbon dioxide being evolved in abundance, and a strong odour of aldehyd being recognised, which, on further addition of the oxidising liquid, was changed into that of acetic acid. By distillation, an acid liquid was obtained, which, on boiling with silver carbonate, yielded a silver salt, which crystallised in the well-known needles of silver acetate.

0·3013 of this salt left on ignition 0·1935 silver.

Silver acetate contains	Found.
64·67 per cent Ag.	64·22 per cent.

The oxidation products (carbon dioxide and acetic acid) prove sufficiently that the structure of the glycol is expressed by the formula $CH_3—CH(OH)—CH_2(OH)$, which is that of the known propyl glycol.

The foregoing researches establish a general reaction for converting secondary compounds of the alcohols into those of primary radicals. This is effected by replacing the iodine in secondary iodides by hydrogen, and subjecting the hydrocarbons thus obtained to the action of chlorine, by which the primary chlorides are formed.

Of greater interest, perhaps, as possessing an important bearing on the theory of substitution, is the fact that the second substitution product of propane consists of propylene dichloride having the structure

$$CH_3—CHCl—CH_2Cl.$$

This was the less to be expected, as ethane, C_2H_6 the hydrocarbon next lower in the series, yields, by acting on it with chlorine as second product, ethylidene dichloride, $CH_3—CHCl_2$. Whilst, therefore, in propane first one hydrogen atom in the methyl group is replaced by chlorine, and afterwards one which is combined with the adjoining carbon atom, in ethane the substitution takes place at one and the same carbon atom. The action of chlorine upon propane is certainly in contradiction to all theories of substitution which have been expounded.

In a second communication I propose to describe the higher chlorinated substitution products of propane.

CONTRIBUTIONS TO THE HISTORY OF EXPLOSIVE AGENTS.*

By F. A. ABEL, F.R.S., For. Sec. C. S.

The degree of rapidity with which an explosive substance undergoes metamorphosis, as also the nature and results of such change, are, in the greater number of instances, susceptible of several modifications by variation of the circumstances under which the conditions essential to chemical change are fulfilled.

Excellent illustrations of the modes by which such modifications may be brought about are furnished by gun-cotton, which may be made to burn very slowly, almost without flame, to inflame with great rapidity but without development of great explosive force, or to exercise a violent destructive action, according as the mode of applying heat, the circumstances attending such application of heat, and the mechanical condition of the explosive agent, are modified.* The character of explosion and the mechanical force developed, within given periods, by the metamorphosis of explosive mixtures, such as gunpowder, is similarly subject to modifications; and even the most violent explosive compounds known (the mercuric and silver fulminates, and the chloride and iodide of nitrogen) behave in very different ways under the operation of heat or other disturbing influences, according to the circumstances which attend the metamorphosis of the explosive agent (*e. g.*, the position of the source of heat with reference to the mass of the substance to be exploded, or the extent of initial resistance opposed to the escape of the products of explosion).

Some new and striking illustrations have been obtained of the susceptibility to modification in explosive action possessed by these substances.

The product of the action of nitric acid upon glycerine, known as nitro-glycerine or glonoine, which bears some resemblance to chloride of nitrogen in its power of sudden explosion, requires the fulfilment of special conditions for the development of its explosive force. Its explosion by the simple application of heat can only be accomplished if the source of heat be applied, for a protracted period, in such a way that chemical decomposition is established in some portion of the mass, and is favoured by the continued application of heat to that part. Under these circumstances, the chemical change proceeds with very rapidly accelerating violence, and the sudden transformation into gaseous products of the heated portion eventually results, a transformation which is instantly communicated throughout the mass of nitroglycerine, so that confinement of the substance is not necessary to develope its full explosive force. This result can be obtained more expeditiously and with greater certainty by exposing the substance to the concussive action of a detonation produced by the ignition of a small quantity of fulminating powder, closely confined and placed in contact with, or proximity to, the nitroglycerine.

The development of the violent explosive action of nitroglycerine, freely exposed to air, through the agency of a detonation, was regarded until recently as a peculiarity of that substance; it is now demonstrated that gun-cotton and other explosive compounds and mixtures do not necessarily require confinement for the full development of their explosive force, but that this result is attainable (and very readily in some instances, especially in the case of gun-cotton) by means similar to those applied in the case of nitroglycerine.

The manner in which a detonation operates in determining the violent explosion of gun-cotton, nitroglycerine, &c., has been made the subject of careful investigation. It is demonstrated experimentally that the result cannot be ascribed to the direct operation of the heat developed by the chemical changes of the charge of detonating material used as the exploding agent. An experimental comparison of the mechanical force exerted by different explosive compounds, and by the same compound employed in different ways, has shown that the remarkable power possessed by the explosion of small quantities of certain bodies (the mercuric- and silver-fulminates) to accomplish the detonation of gun-cotton, while comparatively very large quantities of other highly explosive agents are incapable of producing that result, is generally accounted for satisfactorily by the difference in the amount of force suddenly brought to bear in the different instances upon some portion of the mass operated upon. Most generally, therefore, the degree of facility with which the detonation of a substance will develope similar change in a neighbouring explosive substance, may be regarded as proportionate to the amount of force developed within the shortest period of time by that detonation, the latter being, in fact, analogous in its operation to that of a blow from a hammer, or of the impact of a projectile.

Several remarkable results of an exceptional character have been obtained, which indicate that the development of explosive force under the circumstances referred to is not always simple, ascribable to the sudden operation of mechanical force. These were especially observed in the course of a comparison of the conditions essential to the detonation of gun-cotton and of nitroglycerine by means of particular explosive agents (chloride of nitrogen, &c.), as well as in an examination into the effects produced upon each other by the detonation of those two substances.

The explanation offered of these exceptional results is to the effect that the vibrations attendant upon a particular explosion, if synchronous with those which would result from the explosion of a neighbouring substance in a state of high chemical tension, will by their tendency to develope

* Abstract of a paper read before the Royal Society, April, 15th, 1869.

* *Proceedings of the Royal Society*, vol. xiii., pp. 205 *et seq.*

those vibrations, either determine the explosion of that substance, or at any rate greatly aid the disturbing effect of mechanical force suddenly applied, while, in the instance of another explosion, which developes vibratory impulses of different character, the mechanical force applied through its agency has to operate with little or no aid; greater force, or a more powerful detonation, being therefore required in the latter instance to accomplish the same result.

Instances of the apparently simultaneous explosion of numerous distinct and even somewhat widely separated masses of explosive substances (such as simultaneous explosions in several distinct buildings at powder-mills) do not unfrequently occur, in which the generation of a disruptive impulse by the first or initiative explosion, which is communicated with extreme rapidity to contiguous masses of the same nature, appears much more likely to be the operating cause, than that such simultaneous explosions should be brought about by the direct operation of heat and mechanical force.

A practical examination has been instituted into the influence which the explosion of gun-cotton through the agency of a detonation, exercises upon the nature of its metamorphosis, upon the character and effects of its explosion, and upon the uses to which gun-cotton is susceptible of application.

RESEARCHES INTO THE

CHEMICAL CONSTITUTION OF NARCOTINE, AND OF ITS PRODUCTS OF DECOMPOSITION.*

By Prof. A. MATTHIESSEN and C. R. A. WRIGHT, B.Sc.

NARCOTINE submitted to the action of water, boiling either in open vessels, or at temperatures above 100° C. in sealed tubes, splits up into meconin and cotarnine,—

$$C_{22}H_{23}NO_7 = C_{10}H_{10}O_4 + C_{12}H_{13}NO_3.$$

Narcotine heated *per se* to about 208° splits up in the same manner, but the cotarnine is at that high temperature immediately decomposed. On heating hydrochlorate of narcotine with ferric chloride, the latter is reduced, and the narcotine converted into opianic acid and cotarnine,—

$$C_{22}H_{23}NO_7 + O = C_{10}H_{10}O_5 + C_{12}H_{13}NO_3.$$

When narcotine is heated with excess of hydrochloric acid for a short time (about two hours), chloride of methyl is formed, and one atom of H substituted for CH_3 in the narcotine. If heated for some days two atoms of H are substituted for two of CH_3. When heated with fuming hydriodic acid, iodide of methyl is formed in such quantities as to prove that three atoms of H are substituted for three of CH_3. Cotarnine has for its formula $C_{12}H_{13}NO_3$, and is capable of crystallising with half a molecule, and with a whole molecule of water of crystallisation. Cotarnine heated with dilute nitric acids yields cotarnic acid and methylamine,—

$$C_{12}H_{13}NO_3 + 2H_2O = C_{11}H_{12}O_5 + CH_5N.$$

When cotarnine is heated with strong hydrochloric acid, chloride of methyl is formed, and hydrochlorate of cotarnamic acid.

Opianic acid, under the influence of nascent hydrogen, is reduced to meconin; the same acid, heated with bichromate of potash and dilute sulphuric acid, becomes oxidised to hemipinic acid. Opianic acid, heated with caustic potash, splits up into meconin and hemipinic acid. This latter acid is capable of crystallising with different amounts of water of crystallisation, crystals with half a molecule, with a whole molecule, and with two molecules of water having been obtained. All the reactions of narcotine and its products of decomposition may be satisfactorily accounted for by the following rational formula:—

$$\left.\begin{matrix} CH_3 \\ (C_{11}H_9O_2)'' \\ (C_8H_4O)'''' \\ (CH_3)_2H \end{matrix}\right\} \begin{matrix} N, \\ O \\ O_3. \end{matrix}$$

* Abstract of a paper sent to the Royal Society, Feb. 18th, 1869.

ON A

NEW METHOD OF MANUFACTURING AND REFINING SUGAR.

By M. F. MARGUERITTE.

IT is well known that the present method of manufacturing sugar, notwithstanding the improvements which it has received of late years, does not nearly allow of the extraction of the whole of the sugar contained in the beetroot, and that the residue contains about 50 per cent of its weight of the substance to be obtained. The combinations of baryta and lime with sugar, observed by M. Peligot, and the discovery of osmose and dyalisis by Messrs. Graham and Dutrochet, have given rise to many attempts to extract from molasses the sugar which it contains in a non-crystallisable form. Some of the elements contained in molasses are already known; by examining the products of its incineration, the exact nature of the bases has been determined, and the existence of potash, lime, and soda, well established; but with regard to acids, colouring and extractive matters, little is known. The two most common methods of obtaining the organic acids are as follows:—First, to precipitate the organic salts by neutral or tribasic acetate of lead, and then to decompose the salts of lead with sulphuretted hydrogen to liberate the acid. Secondly, to treat the salts of potash with a mixture of alcohol and sulphuric acid, which forms sulphate of potash, and dissolves the displaced organic acid. The latter method, which was the one employed by us, has been pointed out by Messrs. Liebig, Gmelin, and Zeise,* for the preparation of various acids. It is simple, always efficacious, and allows of the production of the substance to be obtained without alteration, which is not always the case in the decomposition of organic salts of lead by sulphuretted hydrogen. We therefore treated some molasses with a mixture of excess of alcohol with sulphuric acid. After sufficient stirring, the molasses yielded on the one hand a considerable precipitate, and on the other a highly coloured liquid. There were discovered—

In the Solution.	*In the Precipitate.*
Metapectic acid	Sugar
Parapectic ,,	Metapectine
Lactic ,,	Parapectine
Malic ,,	Apoglucic acid
Burnt bitter principle	Sulphates of potash, soda, and lime†
Mannite	
Sundry colouring matters	

It may be seen that the alcoholic liquid, while retaining certain elements of the molasses, precipitates several products which remain mixed with the sugar and render it impure; whence it follows that this method of analysis cannot be industrially employed for extracting and purifying sugar. Nevertheless, a mixture of alcohol and different acids has more than once been proposed for the treatment of saccharine matter, and a system founded on the employment and reactions of the substances just mentioned has long since been tried, and unsuccessfully, for bleaching and purifying crude sugars.‡ Our previous

* *Annales de Poggendorff*, 1822—1825.

† Messrs. Fischman and Mendès, who have been for some time pursuing this study in my laboratory, will soon, I hope, publish the result of their researches.

‡ M. Paulet, 1837, 1838.

remarks will sufficiently explain why such a method could not succeed. Our mode of conducting the process is altogether different. Instead of precipitating the sugar by an excess of concentrated alcohol, it was suspended in solution by the use of alcohol relatively diluted (85°). Thus it was possible to filter the liquor and remove the sulphates, and most of the insoluble substances. A second volume of alcohol at 95° was then added to concentrate the medium and determine the crystallisation of the sugar. Under these conditions the mean strength of the alcohol is such that the sugar ought to crystallise immediately; however, it only settles very slowly. This temporary inertia of the sugar gives time enough to eliminate in a complete and definite manner all foreign substances, so that the sugar is finally obtained extremely pure. The alcoholic liquid, which thus contains more sugar than it can normally dissolve, assumes the condition of supersaturation.

This is a well-known phenomenon, especially since the labours of M. Gernez, and constantly occurs in saline and saccharine solutions. The condition of supersaturation being once established, it is then easy to effect a rapid crystallisation of the sugar by the addition of that substance itself in either crystals or powder. In fact, the addition of pulverised sugar to the alcoholic liquid induces, in a very short time, a total precipitation of all the sugar it contains, in the same way as the presence of crystals in syrups from manufactories and refineries, developes crystallisation, though in a much slower manner.

The alcoholimetric degree of the solution rises, the volume of added sugar increases, and in less than five hours the crystallisation is complete, whilst, in the absence of foreign crystals, it would not have terminated in eight days, or even longer. The mode of operation is as follows:—Mix, by agitation, 1 kilogramme of molasses, marking 47° Baumé in the cold, with 1 litre of alcohol at 85°, accidulated with 5 per cent. of monohydrated sulphuric acid. The liquid thus obtained is filtered, and receives the addition of 1 litre of alcohol at 95 degrees; it will then furnish, upon contact with 500 grammes of powdered sugar, an excess of 350 grammes of pure sugar,* say 35 per cent of the weight of the molasses, or 70 per cent of the sugar which it contains (50 per cent). The composition of the product, after being bleached with its own volume of alcohol at 95 degrees, and then dried, is as follows:—

Crystallisable sugar	99·50
Ash..	0·05
Glucose..	inappreciable traces.

Such is the operation, whose industrial progress and success are based on a purely scientific observation, which is here applied in a very interesting manner. About 10,000 kilogrammes of saccharine matter (molasses, third of the manufactory, last of the refineries) were treated in this manner, and gave considerable augmentations upon the normal yield, these being of course always in proportion to the actual quantity of molasses containing the product treated.

For the practical trial of this process recourse was had to the kindness of one of our friends, M. de Sourdeval, who was good enough to place at our disposal his works at Laverdines, and to aid us with his advice.

Finally, this process is applicable to all saccharine matters without exception, and presents the following advantages:—

1. The extraction of from 35 to 38 kilogrammes of sugar from 100 kilogrammes of molasses, that is, an increase upon the total yield of from 24 to 26 per 100.

2. The sugar is obtained directly and immediately, without the dissolvings, bakings, and loss, inherent to the ordinary process.

3. An almost entire suppression of bone-black in manufactories and refineries.—*Comptes Rendus.*

* By adding to the alcoholic liquid 0·006 of chloride of calcium or barium, to precipitate the last traces of the sulphates which remain dissolved, the sugar will be rendered free from sulphates and chlorides.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, April 15th, 1869.

Dr. A. W. WILLIAMSON, F.R.S., President, in the Chair.

WHEN the minutes of the preceding meeting had been read,

Mr. CHAPMAN said that several gentlemen had questioned him about the action of nitric ethers on acetic acid, and he supposed he must have forgotten to mention that the decomposition only occurred in the presence of concentrated sulphuric acid.

After a slight discussion, in which it was stated that the report in the CHEMICAL NEWS was correct, the words "In the presence of sulphuric acid" were ordered to be inserted in the minutes, which were then confirmed.

The certificates of the following gentlemen were read for the second time:—E. Meusel, University College; J. M. Muir, Shortland, Thames Gold Field, New Zealand; and A. W. Reinold, Merton College, Oxford.

The certificates of J. T. Bottomley, M.A., Demonstrator of Chemistry, King's College, and of F. Braby, F.G.S., were read for the third time, after which the gentlemen were balloted for, and duly elected.

Mr. CHAPMAN read a paper by himself and Mr. M. H. Smith "*On Propyl Compounds Derived from the Propylic Alcohol of Fermentation.*"

They operated on that portion of fusel oil which remained after the amylic, butylic, and ethylic alcohols had been as perfectly as possible removed. It boiled from 79° C. to 106°. It was converted into bromides, and the bromides fractionally distilled. From the mixture of bromides, the bromide of propyl is separated by fractional distillation without much labour. It is a colourless liquid, boiling at 70½° C., and of sp. gr. 1·3532 at 16° C. The alcohol was obtained from the bromide by converting it into acetate, by digestion with acetate of potash and acetic acid. The acetate so obtained was contaminated with traces of bromide, to remove which it was digested with strong ammonia, which converted the bromide into bromide of propylamine, and the acetate partially into the alcohol. The mixed alcohol and acetate were treated with caustic soda, whereby it was at once and completely converted into the alcohol.

The alcohol is a colourless liquid of strong but not oppressive odour; it boils at 97° C., and its sp. gr. is 1·8120 at 16° C. On oxidation, it yields propionic acid.

The iodide was prepared from the alcohol by digestion with excess of strong hydriodic acid; it boils at 102° to 103°, and has a sp. gr. of 1·7343 at 16° C.

The iodide and bromide yield no olefine on treatment with alcoholic potash.

Mr. CHAPMAN then read a note "*On Bromide of Amyl*" by himself and Mr. M. H. Smith.

They prepared bromide of amyl by the action of hydrobromic acid on amylic alcohol. They find the bromide has not been correctly, though variously, described. According to these observations, it is a mobile liquid, boiling at 121° C., and of sp. gr. 1·2173 at 16° C. They drew attention to the fact that the intervals between the boiling points of the bromides of methyl, ethyl, and propyl are constant, viz., about 29° C.; that between bromide of propyl and bromide of butyl is only 22°, but that the interval between the bromides of butyl and amyl is again 29°.

		Differences.
Bromide of methyl boils at	13°	
		29
„ of ethyl „ at	42°	
		28½
„ of propyl „ at	70½°	
		21½
„ of butyl „ at	92°	
		29
„ of amyl „ at	121°	

They explain this by the fact that the butyl and amyl are not normal radicals.

They express a doubt as to the possibility of obtaining pure bromide of amyl by the action of bromine and phosphorus on the alcohol.

The PRESIDENT thought the subject of the paper particularly important. Every addition to their knowledge of organic chemistry was of value. He thought that on a former occasion Mr. Chapman made a statement regarding the origin of fusel oil, when he (the President) was unfortunately absent.

Mr. CHAPMAN explained that the fusel oil in question was about twelve or thirteen years old, and was obtained at the time when there was a demand for amylene. He had operated on the lower portion.

Professor WANKLYN made a verbal communication touching the atomicity of sodium. He said that the researches which had occupied him during the last few months had tended to convince him that sodium was an eminently polyvalent element. The crystalline compound obtained by acting on excess of absolute alcohol with sodium, and which was endowed with great stability, bearing a temperature of 100° C. without alteration, had the empirical formula $C_{16}H_{23}NaO_4$. In this compound sodium appeared to be *seven-valent*, thus :—

$$\left.\begin{matrix} C_2H_5O \\ C_2H_5O \\ C_2H_5O \\ C_2H_5O \\ H \\ H \\ H \end{matrix}\right\} Na^{vij.}$$

In a great number of compounds which had been recently produced in the course of the investigation, sodium occurred in at least a three-valent state, thus :—

$Na'''\left\{\begin{matrix}(C_2H_4)'' \\ OH\end{matrix}\right\}$ Hydrated oxide of ethylene-sodium (or (absolute ethylate of sodium).

$Na'''\left\{\begin{matrix}(C_2H_4)'' \\ [O(C_2H_3O)]'\end{matrix}\right\}$ Acetate of ethylene-sodium.

$Na'''\left\{\begin{matrix}(C_2H_4)'' \\ [O(C_5H_9O)]'\end{matrix}\right\}$ Valerianate of ditto.

$Na'''\left\{\begin{matrix}(C_2H_4)'' \\ [O(C_7H_5O)]'\end{matrix}\right\}$ Benzoate of ditto.

$Na'''\left\{\begin{matrix}OC_2H_5 \\ H \\ Cl\end{matrix}\right\}$ Compound got by treating hydrated oxide of ethylene-sodium with HCl.

$Na'''\left\{\begin{matrix}OC_2H_5 \\ C_2H_3O \\ Cl\end{matrix}\right\}$ Compound got with chloride of acetyl.

$Na'''\left\{\begin{matrix}OC_2H_5 \\ H \\ SH\end{matrix}\right\}$ Compound got with H_2S.

Many other such compounds can doubtless be produced, inasmuch as the hydrated oxide of ethylene-sodium manifests this tendency of combining with so many various reagents.

The common sodium compounds are regarded by Professor Wanklyn as being not, properly speaking, compounds in which sodium is mono-valent, but complex compounds, thus :—

$$\left(\begin{matrix}Na''' \\ \| \\ Na'''\end{matrix}\right)''Cl_2$$

is common salt.

The PRESIDENT remarked that the question of the equivalent value of elements was one in which there was, at present, room for difference of opinion. Mr. Wanklyn's views were likely to be useful if followed up by himself and other members, so as to come to a distinct and definite decision. He thought that in many parts of their progress in science, they attended too exclusively to one particular order of phenomena, without comparing their conclusions with other parts of science. Until they obtained a compound of sodium with three monads, they must have some hesitation in assigning to it, as a general principle, the classification of triad functions. At the same time, it seemed to him quite natural to suppose that a monad, such as sodium usually appeared to be, might, in certain cases, act as a triad. But it was a question whether it was more in accordance with its general behaviour to assign to it those functions which it appeared, in exceptional cases, to assume; or to say that sodium was a monad, and to explain the exceptional cases by the special hypothesis which seemed to suit them best. Mr. Wanklyn was probably aware that many of them might be represented as a monad to sodium. Sodium, combining with three of acetyle, seemed to favour Mr. Wanklyn's view; but when they had three times that group—acetyle, two carbon, and one oxygen, a union amongst those elements themselves might be conceived, forming a radical which might itself be monadic, and that circumstance was the difficulty in organic bodies. He (the President) thought that organic bodies must generally obey those principles, which were clearly established among mineral compounds.

Mr. VERNON HARCOURT could not understand why it was more natural to suppose that the combination of those molecules of alcohol which had been regarded as a molecule of sodium and alcohol should not be rather analogous to the water of crystallisation with any hydrate or any other salt. In the instance before them they had, besides sodium hydrate, other combinations of the sodium hydrate; when the solution was evaporated, they obtained crystals—he did not remember whether they contained three molecules of water of crystallisation, but, following Mr. Wanklyn's formulæ, he would write them thus :—

$$\left.\begin{matrix} HO \\ H \\ HO \\ H \\ HO \\ H \\ HO \end{matrix}\right\} Na^{vij.}$$

Supposing that the crystals contained three molecules of water of crystallisation, there would be a compound similar to that of the new sodium alcohol, which would furnish an argument, and a very weak one, for regarding the sodium as being heptatomic.

Professor WANKLYN regarded the combination of salts with their water of crystallisation as real compounds. If a great deal of maltreatment was necessary to break up the hydrate of sodium, he would consider the combination as good a chemical compound as any he knew. If a compound, containing the elements of alcohol and chloride of sodium, were admitted to be a genuine chemical compound, and if the ordinary values were assigned to the carbon, oxygen, and chlorine, could it be expressed otherwise than by writing sodium as triatomic? With regard to the ordinary sodium compounds, he considered that the sodium was merely complex sodium, or diatomic.

A slight discussion ensued between Dr. Debus and Mr. Wanklyn as to water of crystallisation, &c., of compounds, after which

Mr. CHAPMAN said that unless they were prepared to abandon the atomicity theory, they must admit that when two compounds unite, they have a bond with which to hold themselves together. If they had a certain compound of chloride of sodium with anything else, he thought that they had nearly perfect proof that either chlorine or sodium —most probably both—were not monads; otherwise there was no reason why the compound should hold together. It could only enter into combination with another body if that body was diatomic, and then only by splitting up into its elements in doing so.

After some further remarks by Dr. Debus, Mr. Chapman, and Mr. Newlands.

The PRESIDENT said it was very important to know what was meant by *atomicity* in contradistinction to

equivalence. He thought the words had received a very distinct definition, which really ought to be adhered to. The only difference he knew in the consistent use of the word was, that atomicity was a real or untrue kind of equivalent which was rigid, absolute, and unchangeable. They had used the word in a very different sense that evening, and he thought in one that ought to be conveyed by the word *equivalence*. Introducing such words as *bonds* he believed quite unnecessary, because a "bond" was a physical image, and nothing whatever could be expressed by that word which could not be expressed without it. The habitual use of such a word must be productive of very considerable injury to the theoretical habits of those who used it. He would not express any opinion as to whether the atomicity theory was right or the equivalence theory, but they were different. For his own part, he thought the rule was to find that elements were capable, under different conditions, of assuming different equivalence of value; but it was, he thought, going a little further than the fact, to say they must all be capable of that; the common case was that elements changed their equivalent value, and it was reasonable to suppose they all did so, and by increments of two.

The Society then adjourned.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, April 6th, 1869.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

Dr. JOULE, F.R.S., gave an account of his endeavours to improve the instrument know as the *dip circle*.

A paper was read "*On the Chemical Formula of Alizarine*," by EDWARD SCHUNCK, Ph.D., F.R.S., &c. (See page 193).

FRENCH ACADEMY OF SCIENCES.

Monday, April 12th, 1869.

THE first paper read at this meeting, was one on the "*Synthesis of a New Butylen—the Ethyl-Vinyl*," by M. Ad. Wurtz.

This substance may be obtained by two entirely distinct methods; either by suffering the iodides of the alcohol radicals to act upon sodium, or by making the alcoholic bromides react upon zinc ethyl. By the first method, the author obtained methyl-allyl; by the second, the vinyl-ethyl has been obtained. This is, at ordinary temperature, a gas, but becomes a liquid at—5° C. With bromine, it forms a bromide, boiling at 166°. Submitted to the action of hydriodic acid, and heated in a sealed tube, a liquid is obtained which is very similar to iodide of butyl, boiling, as the latter does, at 121°. The specific gravity of this iodide of ethyl-vinyl is 1·634; it differs from the iodide of butyl by its behaviour with acetate of silver, in contact with which the iodide of ethyl-vinyl is decomposed, forming an acetate, boiling at 110° C.

The author does not, for the present, desire to enter into further details, which he reserves, after having more accurately studied the origin of this substance.

Methyl-allyl boils at about 159° C., and has, at 0° C., a specific gravity of 1·8299.

The other papers read do not belong to the domain of sciences treated in our paper.

We read, however, under the same heading as above, in *Cosmos*, something which may find conveniently a place here. It appears that the well-known Swiss *savant*, De la Rive, is at present at Paris, and engaged in studying the propagation of electricity in gas and rarefied vapours. His assistant, Dr. Sarrazin, has noticed some hitherto unknown phenomena of phosphorescence. As soon as pure oxygen is reduced to a pressure of only two millimetres or less, it becomes exceedingly luminous under the influence of electricity. No other known gas is possessed of this property. All compound gases which contain oxygen become also luminous, and most so the protoxide of nitrogen. The Doctor has found that the cause of this phosphorescence is due to the formation of ozone, since it does not take place when, previous to passing an electric current through the gas, powdered metallic silver has been introduced into the space containing the gas, but the silver becomes rapidly oxidised.

While engaged in studying the part which sulphuric acid plays in these phenomena, Dr. Sarrazin found that when a small quantity of this acid, which is considered non-volatile at ordinary temperatures, was confined along with nitrogen gas, for instance, in a gas jar, and an electric current passed through, a very intense luminosity was caused, notwithstanding nitrogen is not by itself rendered luminous under these conditions. The author found that there was decomposition of sulphuric acid, with formation of ozone, and that the phenomena ceased when powdered silver was introduced.

CORRESPONDENCE.

ON SOLUTIONS OF GLAUBER'S SALT.

To the Editor of the Chemical News.

SIR,—Your correspondent "Crystal" has written twice to ask for instructions how to prepare, for a lecture experiment on sudden crystallisation, a supersaturated solution of Glauber's salt without breaking the flask.

It is easy to do this if the heat be properly managed.

The salt parts with its ten atoms of water of crystallisation with so much ease, that if the heat be too suddenly applied, the anhydrous salt is thrown down in the form of a fine powder, which makes the flask bump, or causes it to crack, by fusing and by preventing convective currents. When once the anhydrous salt begins to form, the evil is increased by raising the temperature, for by this means its solubility is diminished.

As the ordinary solution of this salt is one of the anhydrous, and not of the 10-atom or of the 7-atom variety, attention must be paid to the point at which the ordinary 10-atom salt fuses in its water of crystallisation; that is, the point at which the anhydrous salt dissolves in the 10 atoms of water that accompany the ordinary salt. It does so at about 93° F. Now, in making a solution of six, five, or four parts salt to one of water, the flask containing one of these proportions should be gently heated with constant agitation over a spirit lamp, or other source of heat, or in a water bath not over 100°, so that the contents of the flask may not much exceed 93°, or from that to 98°. Under these conditions, the salt will quietly melt down into a clear solution, which may be then left to boil. The boiling may be greatly facilitated by the addition of some fragments of cocoa-nut shell charcoal, or even of a lump of coke of or pumice stone; but the charcoal is the best, on account of its superior density.

The boiling solution should be filtered into tubes, flasks, or bottles, made chemically clean by washing in caustic alkali, or sulphuric acid, spirit of wine, &c., and rinsing. The tubes, &c., may stand in hot water while being filled; or when filled, they may be passed over the source of heat, so as to raise them to near the boiling point before being plugged with cotton wool.

Such solutions may be kept for a length of time, clear and bright, without any change. On taking out the cotton wool, crystallisation sets in from the surface, and proceeds rapidly downwards, converting the whole into a solid mass, so that the vessel may be inverted without any escape of liquid.

I think it is a loss to the lecture table that solutions of this salt are confined to the single illustration of sudden crystallisation; whereas a whole lecture might be profitably devoted to the consideration of this salt, as it respects the phenomena of supersaturation and the action of nuclei.

Did your space permit, I would write such a lecture; but I can only point out briefly a few experiments.

1. Put a tube, containing a cold but highly supersaturated solution, into a freezing mixture at 20° to 30° F.; in a few seconds, well-shaped octahedral crystals of the anhydrous salt will begin to descend. The tube may now be wiped and exhibited at the lantern, or handed about.

2. If the neck of a large flask be slipped over the neck of one of the flasks containing the boiling filtered solution, and this be set aside in a cold place for many hours, there will be found at the bottom of the flask crystals of the modified 7-atom salt (four-sided prisms, with a rhombic base). They should be bright and transparent. On inverting the flasks, the mother liquor may be discharged into the empty flask. If this be not clean, the liquor will become quite solid; but, with care (warming the neck of the smaller flask is a good plan), the crystals can be disengaged from the supersaturated mother liquor, and left to drain. If the crystals of the 7-atom salt be touched with a bit of wire or other solid, the point touched immediately becomes opaque, and the opacity spreads in all directions, until the whole mass becomes like the boiled white of egg.

3. Before closing one of the tubes with cotton wool, touch the inner surface at one spot with the finger slightly greasy. When the tube is cold, it may be inclined so as to bring the solution into contact with various parts of the glass: the clean portions have no effect; but the moment the solution touches the edge of the finger mark, crystallisation sets in.

4. If the solution be filtered into a stoppered bottle, and the bottle be closed and tied over, and shaken so as to wet every part, it may be left to cool. When cold, the bottle may be violently shaken; and the air, though long in separating, does not act a nucleus. On loosening the stopper, air streams in, and drags in a particle of dust, which immediately acts as a nucleus.

5. Solids, whether porous or compact, boiled up with the filtered solution, are inactive when the solution is cold. So, also, is a glass rod, &c., made chemically clean. Or a metal or glass rod, passed through the plug, held in the boiling steam, and left suspended in the flask, is inactive when the solution is cold. Such a rod may become covered with a crystalline crust of the salt, and even this is not a nucleus.

6. A striking way of showing the sudden crystallisation of the salt is to boil a filtered solution in a flask, put the flask on a plate, and cover this with a bell jar. It may be left for weeks in this state without crystallising; but the moment after the bell glass has been lifted off the solution becomes solid.

7. If vessels with necks of different diameters be opened, the solutions are long in crystallising in proportion as the diameters are small. In vessels with very narrow necks, the solutions may not crystallise at all until a nucleus be inserted.

8. Faraday, in one of his juvenile lectures, gave some idea of the heat liberated during the crystallisation, by emptying a flask upon the bulb of a large spirit thermometer. The temperature commonly rises to about 85° F.; but the best salt for showing this effect in a lecture experiment is the sodic acetate. It is easy to show a rise from 10° to 105° F.

Many other experiments might be shown, such as the easy fusibility of the 7-atom salt, the milky appearance when the chilled solution is shaken, the varied action of nuclei, &c.; but these and other illustrations will natually occur to any one who is going to give a physical lecture on Glauber's salt.—I am, &c.,

C. TOMLINSON.

Highgate, N., April 19th, 1869.

JARGONIA.

To the Editor of the Chemical News.

SIR,—As some question has arisen about what Mr. Sorby has done, I think it might be well to give extracts from two of the letters received from that gentleman, during our long correspondence relative to a recent paper* in the *Proceedings of the Royal Society*.

"Sept. 30th, 1868.

"I forget whether I told you that I had discovered the most remarkable spectrum that probably anyone ever saw, in a zircon from Ceylon. It is quite unlike anything previously seen. It contains about a dozen absorption bands, which are not mere shades, like what is generally seen in solid bodies, but in narrow perfectly black lines, like those seen in the spectra of coloured gases. It is not due to zirconia, because some zircons show no trace of such a spectrum. As far as I can make out, the lines are not due to any substance known to produce absorption bands. So far, it is a complete puzzle, and I am half inclined to believe that it may turn out to be due to some unknown element. Unfortunately the amount of material at disposal is far too small to admit of analysis, and curiously enough, it does not give any bands when melted with borax, but only a colourless bead. I may say that the mineral which gives this wonderful spectrum is nearly colourless, and becomes almost absolutely so when red-heated, and remains colourless, but gives the same wonderful bands, when cold."

"Oct. 23rd, 1868.

"I have been led into a long series of work by the probable new substance. I am endeavouring to determine the spectra of all known elementary substances when combined with silica. There are only a very few that I have not been able to study, and hope to be able in time. So far as I see, no known substance would give the spectrum of the jargon I named.

"I have since examined a number of jargons and other zircons. There does not seem to be a trace of the new substance in any except those from Ceylon, and most of these only contain a small quantity, in comparison with the very remarkable specimen which must contain so much.

"I do not know if I told you that I suspect the existence of a second new substance. I may be wrong in both cases; but it seems difficult to draw any other conclusion from the facts at present known."—I am, &c.,

P. J. BUTLER.

55, De Beauvoir Road, N.
April 19th. 1869.

* "On the Structure of Rubies, Sapphires, Diamonds, and some other Minerals," vol. xvii., pp. 291—302.

MISCELLANEOUS.

COMPLIMENTARY DINNER TO DR. ODLING.

ON the evening of Tuesday last, April 20th, a number of gentlemen who have been associated with Dr. Odling as past and present members of the Council of the Chemical Society in the thirteen years during which he has filled the office of Secretary, entertained the Doctor at a complimentary banquet, at the Albion Tavern, Aldersgate Street. The chair was occupied by Dr. Warren De La Rue, F.R.S., V.P.C.S., who was supported right and left by Dr. Odling, F.R.S., Dr. Tyndall, F.R.S., Professor Williamson, F.R.S. (Pres. C. S), Sir Benjamin C. Brodie, Bart., F.R.S., &c., &c. The following is a list of those who took part in the entertainment:—Messrs. F. A. Abel, F.R.S.; E. Atkinson; J. Anderson, M.D.; J. Lowthian Bell; G. B. Buckton, F.R.S.; F. C. Calvert, F.R.S.; D. Campbell; A. H. Church, M.A.; W. Crookes, F.R.S.; H. Debus, Ph.D., F.R.S.; F. Field, F.R.S.; D. Forbes, F.R.S.; G.

C. Foster; J. H. Gilbert, Ph.D., F.R.S.; J. H. Gladstone, Ph.D., F.R.S.; D. Hanbury, F.R.S.; A. V. Harcourt, F.R.S; C. Heisch; H. Letheby, M.A., M.B.; G. D. Longstaff, M.D.; N. S. Maskelyne, M.A.; A. Matthiessen, Ph.D., F.R.S.; G. H. Makins; E. J. Mills; Hugo Müller, Ph.D., F.R.S.; W. Marcet, M.D., F.R.S.; E. C. Nicholson; H. M. Noad, M.D., F.R.S.; W. H. Perkin, F.R.S.; D. S. Price, Ph.D.; A. P. Price, Ph.D.; T. Redwood, Ph.D.; W. J. Russell, Ph.D.; J. Denham Smith; A. Smee, F.R.S.; J. A. Voelcker, Ph.D; H. Watts, B.A., F.R.S.; J. Williams; J. T. Way; and J. A. Wanklyn. Letters expressing regret at being unable to attend were read from E. Frankland, Ph.D., F.R.S.; T. Graham, D.C.L., F.R.S.; A. W. Hofmann, Ph.D., LL.D., F,R.S.; H. Bence Jones, M.D., F.R.S.; J. B. Lawes, F.R.S.; W. A. Miller, M.D., LL.D., V.P.R.S.; Lyon Playfair, C.B., M.P., Ph.D., F.R.S.; H. E. Roscoe, B.A., Ph.D., F.R.S.; R. Angus Smith, Ph.D., F.R.S.; E. Schunck, Ph.D., F.R.S.; J. Stenhouse, LL.D., F.R.S.; and Col. P. Yorke, F.R.S. After the usual loyal toasts, the Chairman proposed, in eloquent and appropriate terms, the toast of the evening, "The Health of Dr. Odling;" and drew attention to a handsome silver tankard, which had been presented by some of those present, appropriately inscribed, for Dr. Odling's acceptance, as a memento of this day. After this had been filled with an "ethylic compound of complex composition and high saturating power," as the Chairman aptly described it, and had been passed round as a loving cup to all present, it was presented to the Doctor. The Chairman concluded his able speech amid loud and continued applause; and the toast was drunk upstanding, amidst enthusiastic cheers. Dr. Odling replied in feeling and impressive words, in which he spoke of the great advantage and pleasure it had been to him to form the acquaintance of those distinguished men who had filled the Presidential chair, during the thirteen years in which he had occupied the Secretaryship of the Chemical Society. Appropriate speeches were afterwards made by Professor Williamson, as President of the Chemical Society; Professor Tyndall, on behalf of the visitors; Sir Benjamin Brodie, Bart., Messrs. Harcourt, Perkin, and Dr. H. Müller, as Secretaries; Professor Abel, Dr. Gladstone, Dr. Longstaff, Professor Anderson, and others. In the intervals between the speeches, Professor Abel performed a selection of operatic music on the piano, and songs, comic and otherwise, were sung by Mr. F. Field, and also by Col. Boxer, Captain Goodenough, Col. De La Rue, and Mr. J. C. Brough, who were present as guests. Great credit is due to Messrs. Abel, Müller, and Nicholson, who formed the executive committee, for the admirable manner in which everything was organised.

Death of Professor Nicklès.—We learn from a short notice in the *Moniteur Belge* of the 14th inst. that Professor Nicklès, of the Faculty of Sciences of Nancy, Dèpartment de la Meurthe, France, has died suddenly, in consequence of accidentally inhaling, as it appears, the vapour of concentrated hydrofluoric acid, while engaged in making experiments to isolate fluorine. The deceased was born at Erstein (Bas-Rhin) on the 30th of October, 1820, was appointed in 1854 to the Professorship he held, and in 1857 was made corresponding member of the Council General of Public Instruction. The printed list of his many and valuable published scientific works occupies a complete page in the well known *Biographisch-Literarisches Handwörterbuch zur Geschichte der exacten Wissenschaften.*

Gold Discovery in Uist.—According to rumours current in Shetland, the Lerwick correspondent of the *Scotsman* writes:—"It seems that gold has been discovered in Uist: it is said to exist in two localities, but whether it will pay for working has not been determined yet. There are two islands named Uist, one named North and the other South; both are situated off the Western Coast of Scotland's mainland, and belonging to the Hebridean Group of Isles.

Atomic Weights.—We observe, and have read with great pleasure, a brief, but, at the same time, very clearly and highly finished paper on this subject in Spon's "Dictionary of Engineering." This paper, written as it evidently is, by a highly accomplished scholar and mathematician, as well as scientific chemist, deserves not only to be read and used by engineers, but will undoubtedly prove very acceptable to many chemists, and especially to students of chemistry, who will find in about eight octavo pages the whole doctrine of Stoechiometry fully, clearly, and comprehensibly explained. The paper alluded to occurs in Nos. 6 and 7 of the work, each part of which may be had separately.

Applied Science in Italy.—We have to acknowledge the receipt of two small papers from M. Emile Kopp, viz., two printed copies of decrees of H. M. the King of Italy, officially published, one dated the 30th of December, 1866, the other the 14th of November, 1867. The former relates to a reorganisation of the Royal Italian Museum, which is a kind of polytechnic school and agricultural college combined. From the different schedules added to this decree, it appears that a very well selected and comprehensive course of lectures is ordered and intended to be given. The latter decree relates to the approval by His Majesty of the regulations made by the Italian Secretary of State for Public Instruction for the Royal School of Applied Science and Engineering at Turin. We have to confess that, looking over the *series lectionum*, nothing of this kind of instruction, or anything approaching to it established by the State, is to be found in the United Kingdom. No doubt the Italians will, as we hope, highly appreciate the excellent opportunities given them at a very trifling cost, to obtain that practical and scientific instruction they are highly in want of, in order to be enabled to fully develop the eminent natural resources of their beautiful country, once the chief seat and depository of learning, art, and science in the world.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Synthesis of Alizarine.—(*Moniteur Scientifique*, No. 296, April 15th, 1869.)—For a number of years past many scientific chemists have tried to obtain alizarine by artificial means. In the year 1861, M. Roussin thought he had succeeded, by withdrawing from binitronaphthaline, $C_{10}H_6(NO_2)_2$, two equivalents of oxygen, and by converting at the same time the nitrogen into ammonia. Although this experiment was unsuccessful, it has no doubt been made the starting point for the very important solution of this problem, which MM. Graebe and Liebermann, at Berlin, have just brought to a highly successful issue. The two last-named gentlemen found that when alizarine obtained from madder-root was acted upon by powdered zinc, a hydrocarbon was generated, which, instead of naphthaline, proved to be paranaphthaline, which, according to the researches of MM. Anderson, Fritzche, Limpricht, and Berthelot, has the following formula:—$C_{14}H_{10}$; accordingly, MM. Graebe and Liebermann consider that the formula for alizarine should be $C_{14}H_8O_4$. It will be observed that this formula differs from that of paranaphthaline only by having two atoms, four equivalents of oxygen more, and two of hydrogen less, than that of paranaphthaline. The process of transformation of paranaphthaline into alizarine consists of three operations:—First, the paranaphthaline, also named anthracen, $C_{14}H_8$, is converted into anthraquinone, $C_{14}H_8O_2$, which is done by either heating one part of anthracen with two parts of bichromate of potassa and sulphuric acid, or by heating the anthracen with bichromate of potassa and anhydrous acetic acid; the anthraquinone thus obtained is first washed with water crystallised from alcohol or benzol, and so purified constitutes a yellow-coloured solid, crystallising in needles. The second portion of the process consists in substituting, for two atoms of hydrogen, two of bromine in the anthraquinone—in other words, the preparation of bibromanthraquinone—

$$C_{14}H_8O_2+4Br=C_{14}H_6Br_2O_2+2HBr.$$

Two methods may be followed for this operation—either by heating, without simultaneously applying pressure, the anthraquinone with bromine, at temperatures varying between 80° to 130° C.; or, without first preparing anthraquinone, by making the bromine act directly upon the anthracen, thus producing quadribromide of anthracen—

$$C_4H_{10}+8Br=C_{14}H_6Br_4+4HBr.$$

The quadribromide (first discovered by Anderson) thus produced is next oxidised by any of the two methods above described, and then

bibromanthraquinone is obtained; if preferred, chlorine may be substituted for bromine. The third part of the process is the conversion of the bibromanthraquinone into alizarine; for this purpose it is heated, at from 130° to 260° C., with a solution of caustic potassa or soda; a blue colour is produced, which becomes more and more deep at first; when the deepening of the colour ceases, the operation is finished. After cooling, the saline mass is treated with water, the solutions are filtered, an acid is added in excess, and a yellow precipitate ensues, which is the alizarine, or lizaric acid; this, after washing with water and gently drying, is fit for use, and is in all respects identical with that naturally produced in the madder root.

On the Substitution of Graphite by Antimony in Galvanic Batteries.—(*Bul. Mem. de la Soc. Chim. de Paris*, 1869, No. 2.)—According to Böttger, the following arrangement is preferable, as regards force and durability, to either Daniell, Minotto, or Leclanche's batteries. A cylinder of amalgamated zinc is placed in a concentrated solution of equal parts of common salt and sulphate of magnesia; the antimony is placed in a porous cell filled with dilute sulphuric acid.

Abietite (*Les Mondes*) is a substance discovered by Rochleder in the needle-like leaves of the *Abies pectinata;* in many aspects it resembles mannite, from which it differs by its solubility and composition, which may be represented by $C_6H_8O_8$. The said leaves also contain a soluble tannin, $C_{18}H_{12}O_8$, which, by loosing oxygen and hydrogen, is readily transformed into an insoluble modification—

$$4(C_{13}H_{12}O_6) = C_{52}H_{46}O_{23} + H_2O.$$

Action of Hydriodic Acid on Organic Chlorides.—(*Les Mondes.*)—According to A. Lieben, the chlorides of ethyl, butyl, and amyl, and also other chlorinated organic compounds, when heated in sealed tubes with hydriodic acid, are converted into the corresponding iodides without any disengagement of gas. In order to discover whether, perhaps, there were actions of mass in play, the author has reversed the experiment, by treating iodide of ethyl at 130° C. in a sealed tube with hydrochloric acid; there was only a slight trace of chloride of ethyl formed. When chloroform is heated for seven hours consecutively with eleven times its weight of hydriodic acid at 127° in a sealed tube, there is formed hydro-iodoform, iodide of methylene, hydrochloric acid, and free iodine; this reaction may be thus represented:—

$$CHCl_3 + 3HI = CHI_3 + 3HCl,$$
$$CHI_3 + HI = CH_2I_2 + I_2.$$

Some Varieties of Roccella Tinctoria.—J. Stenhouse.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869.)—The most interesting portion of this rather long paper is undoubtedly an improved method for the estimation of the quantity of colouring matter contained in these and similar kinds of lichens. For this purpose, 100 grains of the lichens are to be digested with a dilute solution of caustic soda; this operation should be repeated, in order to make sure of extracting all useful matter. The fluid so obtained is filtered; after filtration it is treated with a solution of hypochlorite of soda of known strength, the addition of which solution produces a blood-red colouration of the fluid, and this continues as long as any colouring matter is left. From the quantity of *eau de javelle* used the quantity of colouring matter may be inferred.

Kyaphenin.—By C. Engler.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869.)—When treating benzo-nitrile with bromine, the author obtained a substance which proved to be identical with that obtained by Cloez on treating chlorobenzoyl with cyanate of potassa. Cloez considers kyaphenin as trio-benzo-nitrile, in consequence of its analogy with kyanaethin. M. Engler has tried in vain to obtain salts of kyaphenin; he states that, unlike Cloez, he did not find ammonia abundantly given off, if kyaphenin were boiled even in sealed tubes at 150° C. with an alcoholic solution of caustic potassa. On treating the kyaphenin in a sealed tube at 220° with excess of fuming hydriodic acid, benzoic acid was formed, besides some iodide of ammonium and a small quantity of an oil, probably hexyl-hydrogen.

On the Existence of a Normal Propylic Alcohol.—By R. Fittig.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869.)—The discovery by Chancel of a normal propylic alcohol in fusel oil has been frequently disputed and contradicted. M. R. Fittig obtained from Dr. Marquard's well-known chemical works, near Bonn, a product which purported to be propylic alcohol, and which, notwithstanding its greater bulk, was made up of different alcohols, containing, on the whole, a very fair proportion of propylic. Instead of trying to separate these alcohols by a fractional distillation, which never yields satisfactory results, the author converted the whole of the raw material, by means of amorphous phosphorus and bromine, into bromides, and after purifying these, he separated them from each other by means of fractional distillation. He obtained a fluid boiling at 71° C., and on submitting it to elementary analysis, obtained from the fluid and its silver salt results which place the existence of Chancel's normal propyl alcohol out of all question. The raw liquid obtained from Dr. Marquard, above alluded to, was found to contain about 10 per cent of propylic alcohol.

Researches on Hungarian Wheat and Wheaten Flour.—By O. Dempwolf.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869.)—It is a well-known fact, that the composition of wheat varies according to climate and soil. At Pesth is established a most extensive depôt and granary for the produce of Hungary, and also a very large establishment for grinding wheat. The analysis of the grain gave the following result for 100 parts:—Water, 10·511; ash, 1·505; gluten, 14·352; starch, 65·407; fatty matter and woody fibre, 8·225; together, 100·000. The existence of sugar could not be proved. The chief ingredients of the ash were found to be—phosphoric acid, 49·902 per cent; potassa, 31·825; magnesia, 14·862 per cent.

On Gummic Acid and some of its Combinations.—M. Felsko.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869.)—Gummic acid was first discovered by Reichardt, in 1863, and its name derived from the fact that this substance (the acid), accompanied by a gum-like matter, is formed when oxide of copper in alkaline solution is acting upon grape sugar. The anhydrous acid has the formula—

$$C_6H_5O_{10};$$

the hydrate is expressed by—

$$C_6H_5O_{10} + 3HO + 6aq.$$

Neutral, or alkaline ammoniacal solutions of the acid are precipitated by chloride of calcium solution. Lime-water yields directly a precipitate. Chloride of iron does not precipitate the acid, or its salts, but does so on addition of alcohol; solutions of platinum and silver become reduced to metal when in contact with the acid. The acid combines with bases and oxides of metals to form salts.

On Bichloruretted Aldehyde.—M. Paterno.—(*Ann. d. Chem. u. Pharm.*, vol. 159, No. 3, March, 1869.)—The author has prepared this substance by distilling a mixture of bichloruretted acetal with from four to six parts, by bulk, of ordinary concentrated sulphuric acid. It is best to perform this operation in a retort, placed in an oil-bath and heated to about 130° C.; the receiver adapted to the retort is kept very cold, and the contents thereof are, after the end of the reaction, rectified. The fluid which comes over between 88° and 90° is the pure bichloruretted aldehyd; this liquid is heavier than water, and soluble therein, and likewise soluble in alcohol and ether; it boils between 88° and 90°, and its vapour strongly affects the eyes. Its elementary analysis yielded the following results:—Carbon, 21·23; hydrogen, 1·77; chlorine, 62·83; its formula is—

$$C_2H_2Cl_2O,$$

and the density of its vapour 3·9.

Phlobaphen.—(*Journ. f. Prak. Chem. v. Erdmann*, 1868, Nos. 23 and 24.)—Phlobaphen, an amorphous kind of tannic acid precipitable by acetate of lead, is, according to Grabowski, the principal constituent of the oak bark. When this phlobaphen is boiled with dilute sulphuric acid, it is split up into sugar and oak-red (eichenroth); this substance, purified as much as possible, and dried at 120° C., proved, on elementary analysis, to yield, in 100 parts—C, 55·4; H, 4·4. Combined with calcium, the composition of this substance is expressed by—

$$C_{26}H_{22}CaO_{14}.$$

The oak phlobaphen is composed according to—

$$C_{26}H_{24}O_{14}.$$

Isodulcite.—(*Journ. f. Prak. Chem. v. Erdmann*, 1868, Nos. 23 and 24.)—Isodulcite is a sugar-like substance derived from quercitrin, by boiling it with dilute sulphuric acid. M. G. Malin has studied the isodulcitic acid obtained from isodulcite by oxidising it with nitric acid; the acid so obtained crystallises, is almost insoluble in alcohol, readily soluble in water, and it does not exercise a reducing action upon an alkaline solution of copper. After having been dried over strong sulphuric acid, the elementary analysis of this substance leads to the formula—

$$C_6H_{10}O_9.$$

The isodulcitic acid is the most highly oxidised substance belonging to a series of compounds which begins with sugar of milk,

$$C_6H_{10}O_5;$$

the acid alluded to originates from isodulcite, in the manner as oxalic acid is derived from alcohol—

$$\underbrace{C_2H_6O}_{\text{Alcohol.}} + 5O = \underbrace{C_2H_2O_4}_{\text{Oxalic acid.}} + 2H_2O.$$

$$\underbrace{C_6H_{14}O_6}_{\text{Isodulcite.}} + 5O = \underbrace{C_6H_{10}O_9}_{\text{Isodulcitic acid.}} + 2H_2O.$$

Conchinine.—(*Journ. f. Prak. Chem. v. Erdmann*, 1868, Nos. 23 and 24.)—The alkaloid belonging to and derived from the Cinchonatrees, known as chinidine, β chinidine, β chinine, B chinine, cinchotine, crystallised chinoidine, and pitoyine, has been christened by Hesse conchinine, because it resembles chinine, as well as cinchonin. In order to prepare this conchinine, which occurs to upwards of 1·6 per cent in pitoya bark, the commercial chinoidine is the best source, since therein the conchinine is largely found. The chinoidine is repeatedly treated with eight times its weight of ether, this solution is filtered, and the ether removed by distillation; the residue is dissolved in dilute sulphuric acid, and afterwards carefully neutralised with ammonia. The solution is next treated with Seignette salt, whereby the tartrates of quinine and cinchonidine are precipitated, while the tartrates of cinchonine and conchinine remain in solution. After having treated the previously-filtered solution with animal charcoal, iodide of potassium is added to the warm solution, whereby hydriodide of conchinin is precipitated as crystalline powder; this salt is decomposed by ammonia, re-dissolved in acetic acid, re-purified with animal charcoal, and, lastly, treated with hot alcohol, from which it separates in crystalline form. The conchinine so obtained is soluble in 2,000 parts of water at 15°, in from 35 to 22 parts of ether, according to temperature, and in 26 parts of 80 per cent alcohol; the substance melts at 168° C., without charring. This substance, which is capable of forming several hydrates, has for its formula—

$$C_{40}H_{24}N_2O_4 + 5Aq;$$

it forms, with acids, salts.

Analysis of Ripe Grapes.—(*Journ. f. Prak. Chem. v. Erdmann*, No. 1, 1869.)—Dr. Classen has done good service to science, as well as technology, by supplying us with these analyses; the grapes, three different kinds, grown in the neighbourhood of Kreuznach, were bought promiscuously in the market-place there:—1,000 grammes of fruit yielded—(1) 577, (2) 952, (3) 1034 grammes, juice; this consisted in 10,000 parts of solid substance dried at 100° C.—(1) 1644, (2) 1897, (3) 2046; grape sugar—1499, 1624, 1740; free acid—72, 68, 48; ash—27·83, 30·95, 40·08. The ash contains, as might be expected, a large proportion of potassa and phosphoric acid as the chief constituents, and beside chlorine, sulphuric acid, lime, silica, and small quantities of magnesia, and oxides of iron and manganese.

Notes on the Manufacture of Soap.—(*Journ. f. Prak. Chem. v. Erdmann*, No. 1, 1869.)—It is a well-known fact that, by an indirect process, a potassa soap may be converted into a soda soap; this is done by adding to a boiling solution of potassa soap a very concentrated solution of common salt; and it is generally taken for granted that, if enough of the latter has been added, the potassa is converted at least chiefly into soda, while chloride of potassium is formed. Neither in chemical nor in technological works the question *how much* of the potassa is substituted by soda has been answered; hence it occured to Dr. Oudemans to ascertain this point, he having a good opportunity to do this by being acquainted with the proprietors of large soap-works. Without entering into the full details of his published paper on the subject, we quote the results obtained by him, which are these:—By the process as executed on the large scale, and yielding excellent produce, only a little more than half, to wit 53·7 per cent, of potassa is replaced by soda, while 46·3 per cent of potassa are left along with the other alkali combined with fatty acids in the curd soap.

NOTES ON LECTURE EXPERIMENTS.

Sudden Crystallisation.—I am afraid I can be of no further assistance to your correspondent "Crystal," as I have never met with the difficulty he describes. The bottle to be filled with the sulphate is thoroughly warmed, and the hot solution filtered into it. The same quantity has been used by me several times, the solidified salt being re-dissolved by placing the bottle in warm water, which is then heated to boiling.—ALFRED H. ALLEN.

Decomposition Cell.—Mr. Woodward's description of a glass cell reminds me of an arrangement I am in the habit of using, and a description of which may be of interest. The cell is made by cementing two pieces of window-glass on to a properly shaped piece of wood, by means of hot pitch. Platinum wires and plates present no difficulty; no clamps are required, and acids have little or no action on the pitch. A few weeks ago, I constructed a cell, by placing a piece of sheet gutta-percha between two glass plates heated before the fire. It lasted a few days, but then leaked; I think I can yet succeed in making it permanent. When the cell is to be exposed to great heat, as from the electric or lime light, the portion of the glass not required for transmitting light, should be covered with tin-foil which of course reflects the heat, instead of absorbing it like the pitch and gutta-percha.—ALFRED H. ALLEN.

NOTES AND QUERIES.

Wood Pulp.—Will any of your obliging contributors kindly inform me how to operate on wood shavings to convert them into white pulp? I have found them difficult to bleach even while employing much of the chloride of lime; the alkali I use is caustic soda, and the acid sulphuric. My results are not at all good; all I can obtain is a yellow pulp.—PAPER.

Electricity and Phosphuretted Hydrogen.—In making phosphuretted hydrogen the following formula is used:—

$$3KHO + P_4 + 3H_2O = 3KPH_2O_2 + PH_3.$$

To the above, in a test tube, I added a small quantity of iodine, and heated gently. In addition to PH_3, I observed for the first time that electricity was given off. Will any of your correspondents kindly explain if there be a connection between the above method of production of electricity and the common method with zinc and sulphuric acid, &c.?—LEX, Liverpool.

[Will our correspondent inform us how the electricity was detected? —*Ed. C. N.*]

Melting and Solidifying Points of Fatty Matters.—M. Wimmel has proved, by a series of experiments, that the generally accepted rule, that the degree of temperature of solidification, and melting of solid fusible substances is exactly the same, does not hold good for fatty substances. Those properly so called—that is to say, those which yield glycerine on decomposition—become solid at a temperature far less high than that at which they become fluid; substances like beeswax and spermaceti become solid immediately their temperature falls below their melting point. M. Wimmel has found that when the solidification is retarded, there is always an increase of temperature when the solidification takes place. The fatty substance known as butter of mace becomes suddenly solid at 33° C., and this solidification is accompanied by a sudden increase of temperature to 42·2°, while the melting point of this fat is 45·5°. Some fats, like beef and mutton suet, do not become clear and quite transparent unless heated far above their melting point, while beeswax and spermaceti become transparent and clear long before they are entirely molten.

Mutual Decomposition.—Analysis of Sewage.—Perhaps you will be good enough to inform a new subscriber under what conditions of temperature and others, sulphate of lime and carbonate of magnesia mutually decompose each other, and form carbonate of lime and sulphate of magnesia; the approximate temperature at which the decomposition takes place; if the transposition of the acids is complete or partial; and, particularly, if the presence of silicate of alumina in large quantity, and of peroxide of iron in small quantity, may be expected to accelerate or retard the effect? And also if you will please point out any treatise showing the best mode of analyses of sewage and of water, particularly the quantitative determination of ammonia of nitrates, nitrites, and of phosphates.—W.

Preparation of Olefiant Gas, and the so-called Dutch Liquid.—Many years ago Mitscherlich discovered a process for the preparation of olefiant gas, which yields it almost continuously, and gives, at the same time, a very pure product. This process is based upon the fact that a sulphuric acid of such strength as to have its boiling point at 165° C. (a mixture of 10 parts by volume of strong sulphuric acid and 3 of water), decomposes the vapour of strong alcohol into water and olefiant gas. The full description of this process and also the simultaneous preparation of elayl-chloride, or Dutch liquid, cannot be well understood without a woodcut; we therefore refer our correspondent to the very elaborate and full description to be found in vol. iv., pp. 545 to 558, of the *Handwörterbuch der Reinen und Angewandten Chemie von Liebig, Wöhler, und Poggendorff*, Brunswick, 1849, which work may be inspected at the Library of the Commissioners of Patents.

MEETINGS FOR THE WEEK.

MONDAY, 26th.—Medical, 8.

TUESDAY, 27th.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."

WEDNESDAY, 28th.—Society of Arts, 8.
—— London Institution, 12. Anniversary.
—— Geological, 8.

THURSDAY, 29th.—Royal Institution, 3. Professor Tyndall, "On Light."
—— Royal, 8.30.
—— Chemical, 8.

FRIDAY, 30th.—Royal Institution, 8. R. H. Scott, Esq., "On the Work of the Meteorological Office, Past and Present."

SATURDAY, May 1st.—Royal Institution, 2. Annual Meeting.

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THE CHEMICAL NEWS.

VOL. XIX. No. 491.

FURTHER RESEARCHES ON JARGONIUM, AND THE CEYLON JARGON.

By H. C. SORBY, F.R.S., &c.

IN my last note I told you that I had found in zircons what appeared to be another elementary substance. I have, since then, made many experiments, and find that the facts are really far more interesting than if they were the effect of a new element. Judging from analogy with all other known substances, no other conclusion could have been formed; but I now find that jargonia exists in two distinct conditions, which have different specific gravities and optical properties. The flamed borax beads give two entirely different spectra, according to the temperature to which the enclosed crystals have been exposed; and there is an analogous difference in the silicates. On taking a pale green jargon, which, naturally, showed a mere faint trace of the absorption bands, and keeping it at a bright red heat for some time, the specific gravity gradually increased from 4·20 to 4·52, and the spectrum then showed all the narrow black absorption bands in as great perfection as my best specimen. This fact is, of course, very interesting; since we can now artificially alter jargons so as to show the bands in the same splendid manner as a few do naturally, and shall thus be able to obtain them without much difficulty, to use as a most excellent natural standard scale, to measure the position of the absorption bands in other spectra.

Broomfield, Sheffield, April 24th, 1869.

ON A NEW ARRANGEMENT OF BINOCULAR SPECTRUM MICROSCOPE.*

By WILLIAM CROOKES, F.R.S., &c.

THIS instrument has been devised to obviate the disadvantages of the ordinary spectrum microscope. The principal features of the new apparatus are the sub-stage and the box of prisms. The former carries a sliding plate to hold the slit and apertures, a spring stop and screws for adjusting them, and a reversed object glass. The slit and this object glass are about two inches apart, and if reflected light is passed along the axis of the instrument, the object glass forms a very small image of the slit in front of it. A milled head moves the whole sub-stage, and screws bring the image of the slit to any part of the field. Beneath the slit is an arrangement for holding an object of irregular surface or dense substance. The stage has a concentric movement, so as to permit the object to rotate and enable the image of the slit to pass through it in any direction.

The direct vision prisms consist of three flint and two crown, fitted in a box screwed into the end of the microscope. By means of a pin they are thrown in or out of action. The object glass screws on in front of the prism box.

By taking the illumination from the sky or a white cloud, Fraünhofer's lines are visible, and by direct sunlight they are seen in great perfection; the dispersion is sufficient to cause the spectrum to cover the whole field, and the achromatism of the lenses being nearly perfect, the lines from B to G are practically in the same focus.

A double image prism near the slit enables two spectra to be seen, oppositely polarised, and the variations in the absorption lines are at once visible. A Nicol's prism as polariser, and another as analyser, can be connected, and these enable the brilliant colours shown by some crystalline bodies when seen by polarised light, to be examined.

If a substance is dark coloured, or the illumination not brilliant, the whole of the light should be passed up the tube to one eye; but when the light is good, the appearance of the spectrum, and the power of grasping faint lines, are greatly improved by dividing the light with a Wenham prism, and using both eyes; whilst the stereoscopic effect thereby communicated to some absorption and interference spectra, throws a new light on the phenomena.

By using a spirit lamp instead of the illuminating lamp, the instrument answers admirably for examining flame spectra: The characteristic yellow, crimson, or green lines are seen beautifully sharp, on introducing sodium, lithium, or thallium into the flame.

* Abstract of a paper sent to the Royal Society, April 23rd, 1869.

ON SOME OPTICAL PHENOMENA OF OPALS.*

By WILLIAM CROOKES, F.R.S., &c.

BY means of the above-described spectrum microscope some curious optical phenomena of opals have been observed.

If an opal which emits a fine broad crimson light is held in front of the slit of a spectroscope, or spectrum microscope, at the proper angle, the light is generally seen to be purely homogeneous, and all that is visible is a brilliant luminous line, varying somewhat in width, and more or less irregular in outline, but very sharp, and shining brightly on a perfectly black ground. If the source of light is now moved so as to shine into the spectrum apparatus through the opal, the above appearance is reversed, and we have a luminous spectrum with a jet-black absorption band in the red, identical in position, form of outline, and sharpness, with the luminous line previously observed.

From these and other experiments it has been found that those parts of the opal which emit red, yellow, green, or blue light are opaque to light of the same refrangibility which they emit. This is, doubtless, a general law, following, of necessity, the mode of production of the flashes of colour.

From the descriptions of the absorption phenomena of a series of opals, the following are selected as the most striking:—

No 1 shows a single black band in the red. When properly in focus this has a spiral structure. Examined with both eyes it appears in decided relief, and the arrangement of light and shade are such as to produce a resemblance to a twisted column.

No. 2 gives an irregular line in the orange. Viewed binocularly, this exhibits the spiral structure in a marked manner, the different depths and distances standing well out; upon turning the milled head of the stage adjustment, so as to carry the opal slowly from left to right, the line is seen to revolve and roll over, altering its shape and its position in the spectrum. It is not easy to retain the conviction that one is looking merely at an absorption band in the spectrum, and not at a solid body possessing dimensions, and in actual motion.

No. 9 shows a very sharp and black band, stretching diagonally across the green, touching the blue at the top, and the yellow at the bottom.

No. 12 gives a narrow, straight, and sharply cut line in the green; this might easily be mistaken for an absorption band caused by an unknown chemical element.

Other opals show an absorption band travelling along the spectrum, almost from one end to the other, as the opal is moved sideways. All these black bands can be reversed, and changed into luminous bands, by examining the opal with reflected light.

* Abstract of a paper sent to the Royal Society, April 23rd, 1869.

CONTRIBUTIONS TO ANALYTICAL CHEMISTRY.*

By Dr. E. FLEISCHER, of Dresden.

On the Separation and Estimation of Copper in the Presence of other Metallic Salts.

In order to ascertain the amount of copper in a liquid which also contains other metallic salts, it will be found advisable to separate the copper from the solution in such a form as will be best adapted to its further estimation.

In analytical estimations of copper by weight, use may frequently be made, in the presence of sulphides easily soluble in weak muriatic acid, of the property possessed by chloride of copper of being precipitated in a warm acid solution by hyposulphite of soda. A drawback of this method is, however, that it does not allow any direct weighing of the dried precipitate, on account of the sulphur which is separated at the same time with the copper sulphide. Some chemists have recommended iodide of potassium, others, especially Rivot, sulphocyanide of potassium, for the separation of copper in acid solutions; neither of these are, however, to be especially recommended for analytical estimation by weight, because they do not allow of precision being attained by direct weighing. On the contrary, both these haloid salts of copper are highly suitable for its separation from other metallic salts and for the analytical determination of copper by measure, because almost all iodides and sulphocyanides collectively are easily soluble in muriatic acid, while, on the other hand, iodide or sulphocyanide of copper is insoluble, so that it is not possible to discover in the filtrate, after precipitation, any trace of copper by the aid of ferrocyanide of potassium. Of course much depends, especially for the complete precipitation of the iodide of copper, upon the means of reduction employed. Salts of sulphurous acid and even protochloride of iron are inappropriate, because iodide of copper is soluble in an excess of sulphurous acid, and still more easily so in sesquichloride of iron; but if a reducing agent be employed in precipitating the iodide of copper, capable, before the addition of iodide of potassium, of reducing cupric salts to subsalts, the precipitation of the iodide will be thoroughly complete. The most convenient reducing agent of this kind, and that best adapted for the purpose, is chloride of tin. If a solution of chloride of copper or blue vitriol be mixed with an excess of chloride of tin, the copper will be transformed into subchloride or subsulphate. On the addition of iodide of potassium, the copper will be so completely precipitated that no trace will be discoverable in the filtrate. As this iodide of copper is, then, one of the most suitable forms in which to analytically estimate copper by measure, I will proceed to describe the method more closely. With the aid of sulphate of peroxide of iron, which it transforms into a salt of protoxide, according to the formula—

$Cu_2I + 2(Fe_2O_3,3SO_3) = 2CuOSO_3 + 4FeOSO_3 + I$,

after separating the simultaneously-deposited iodine, the amount of copper may be easily calculated from that of the protoxide of iron formed, which is found by permanganate of potash. In order to obtain the copper as a chloride in a state of solution, it is necessary either to dissolve the oxide in muriatic acid, or to transform the sulphate into chloride by the addition of chloride of potassium or chloride of sodium. The presence of sulphate of potash will be found in no way detrimental. Nitrates may be treated in the same way, or, if too much free acid be present, it may be decomposed by digesting with excess of protochloride of iron. After the chloride of iron has been formed by one of these two methods, there must be added a proportionately large quantity of sal-ammoniac, say about 100 c.c. fluid, 8—10 grammes solid, salt. With this must be mixed distilled chloride of tin, or the yet stronger solution of chloride of tin and sal-ammoniac, in such a proportion as to transform the whole of the copper into subchloride; if iron be also held in solution it will naturally be reduced to protoxide. It is obvious that a solution can contain no subchloride of copper in the presence of sesquichloride of iron, but that in the presence of chloride of copper it may contain protochloride of iron. If the reduction is sufficient, a paper dipped in strong iodide of potassium will not turn blue. Should it now be wished to precipitate the copper as iodide, an iodide of potassium solution must be added in sufficient quantity, and the *cold* fluid allowed to settle well*. In the presence of much sal-ammoniac this takes place very quickly, while, at the same time, the tendency of the finely-divided iodide to go through the pores of the filter is prevented. The iodide of copper, which is filtered off, must now be washed with a solution of sal-ammoniac until a solution of nitrate of silver in caustic ammonia will no longer render turbid the liquid which runs through, and until the latter will not precipitate Prussian blue from a mixture of diluted sesquichloride of iron with two drops of prussiate of potash. The iodide of copper which was washed is now placed in a solution of nitric acid, chlorine, and free sulphate of peroxide of iron, which more than suffices to transform all the copper into sub-salt; the free iodine is then driven off by heat until iodide of potassium and starch paper is not turned blue by the fumes, and diluted with cold water. The amount of the original protoxide of iron is now estimated with manganate of potash, and then the amount of copper is calculated according to the above-mentioned formula. It will be perceived that it is possible to estimate the liberated iodine by employing closed vessels, from which it is distilled into a solution of iodide of potassium, nevertheless I consider this process as superfluous, since the estimation of iron belongs properly to the most exact analytical methods.

Inasmuch as iodide of copper is an appropriate compound for the estimation of copper, so it is also especially adapted to discover and separate combined iodine in the presence of chlorine and bromine; and it fully replaces the expensive employment of palladium, provided the stated precautions are adhered to, and so much the more as it permits a direct estimation of iodine. An equally convenient method of estimating and separating copper is presented by precipitation by sulphocyanide of potassium. In the absence of sesquioxide of iron, copper can be as easily separated from its solution by sulphocyanide of potassium, when sulphite of soda is used as a reducing agent, as when chloride of tin is employed. The addition of sal-ammoniac is not indispensable, but it effects a better filtration and prevents the separation of oxide of tin.

The sulphocyanide of copper which is deposited from the muriatic acid solution is washed until the washings are not rendered turbid by alkali; the deposit is then digested for some minutes with a solution of caustic soda or potash; the red suboxide of copper now formed is allowed to settle a little and quickly filtered off. It is then washed with hot water until it no longer communicates a red tinge to acidulated sesquichloride of iron; the suboxide is then dissolved in a solution of sulphate of peroxide of iron, and estimated according to the known process. The estimation of copper as a sulphocyanide will be perceived to be rather more detailed than that of the iodide; however, by this method one may avoid the removal of the iodine by large quantities of water, which always takes up time. Moreover, as I have myself proved, sulphocyanide of copper serves as a means of estimation for hydrosulphocyanic acid even in the presence of cyanogen. I have observed in such cases that the transformation of the cyanogen into ferrocyanide of potassium (which is effected by digesting the alkaline solution with oxidised green vitriol) and the subsequent separation of the ferrocyanide of potassium from the acidulated solution, produce a very useful separation of

* Communicated by the Author.

* Here the syphon filter will be found very convenient if the precipitate be not too insignificant.

the cyanogen from the sulphocyanogen, especially if a little chloride of tin be previously added, so that all the iron may be held in the state of protoxide. It has already been remarked that copper can be separated in the presence of salts of other metals by either iodide or sulphocyanide of potassium. Lead, silver, and mercury alone are troublesome; however, silver may be separated by muriatic acid, and lead is precipitated with sufficient completeness by the addition of sulphuric acid. By means of chloride of tin, mercury is also deposited as Hg_2Cl, provided the solution be cold, so that the separation of copper from these three metals is tolerably simple. In the case of native sulphides I prefer, instead of the tedious and troublesome decomposition by *aqua regia*, fusing them with four parts of dry soda, three parts chlorate of potash, and two of common salt; this will effect, in a few minutes, a quiet and decided oxidation of the pyrites. The fused mass is directly dissolved in muriatic acid, and the copper separated from the filtered solution in the form of iodide or sulphocyanide, according to the method above-described.

ON THE

ESTIMATION OF COPPER IN ORES,

BY CERTAIN METHODS FOR WHICH A PREMIUM HAS BEEN AWARDED.*

(Continued from p. 186.)

Dr. Steinbeck's method, which entirely answers to the conditions published by the directors of the mines, embraces three distinct operations, viz.:—1. The extraction of the copper from the ore; 2. The separation; 3. The quantitative estimation of that metal.

I. *The Extraction of the Copper from the Ore.*

A proof centner, equal to 5 grammes of pulverised ore, is put into a flask, and there is poured over it a quantity of from 40 to 50 c.c. of crude hydrochloric acid, of a specific gravity of 1·16, whereby all carbonates are converted into chlorides, while carbonic acid is expelled. After awhile, there is added to the fluid in the flask 6 c.c. of a normal nitric acid, prepared by mixing equal bulks of water and pure nitric acid of 1·2 sp. gr. As regards certain ores, however, specially met with in the district of Mansfeld, some, having a very high percentage of sulphur and bitumen, have to be roasted previous to being subjected to this process; and others, again, require only 1 c.c. of nitric acid instead of 6. The flask containing the assay is digested on a well-arranged sand-bath for half an hour, and the contents only boiled for about fifteen minutes, after which the whole of the copper occurring in the ore, and all other metals are in solution as chlorides. The blackish residue, consisting of sand and schist, has been proved by numerous experiments to be either entirely free from copper, or at the most only 0·01 to 0·03 per cent has been left undissolved.

The extraction of the copper from the ore, according to this method, is complete even in the case of the best quality of ore, which contains about 14 per cent of metal; while, at the same time, the very essential condition for the proper and complete separation of the metal, viz., the entire absence of nitric acid, or any of the lower degrees of oxidation of nitrogen, is fully complied with.

II. *Separation of the Copper.*

The solution of metallic and earthy chlorides, and some free hydrochloric acid, obtained as just described, is separated by filtration from the insoluble residue, and the fluid run into a covered beaker glass of about 400 c.c. capacity: in this beaker has been previously placed a rod of metallic zinc, weighing about 50 grammes, and fastened to a piece of stout platinum foil. The zinc to be used for this purpose should be as much as possible free from lead, and at any rate not contain more than from 0·1 to 0·3 per cent of the latter metal. The precipitation of the copper in the metallic state sets in already during the filtration of the warm and concentrated fluid, and is, owing especially also to the complete absence of nitric acid, completely finished in from half to three-quarters of an hour after the beginning of the filtration. If the fluid be tested with sulphuretted hydrogen, no trace even of copper will be detected; the spongy metal partly covers the platinum foil, partly floats about in the liquid, and, in case either the ore itself or the zinc applied in the experiment contained lead, small quantities of that metal will accompany the precipitated copper. After the excess of zinc (for an excess must be always employed) has been removed, the spongy metal is repeatedly and carefully washed by decantation with fresh water, which need not be distilled, and care taken to collect together every particle of the spongy mass.

III. *Quantitative Estimation of the Precipitated Copper.*

To the spongy metallic mass in the beaker-glass, wherein the platinum foil is left, since some of the metal adheres to it, 8 c.c. of the normal nitric acid are added, and the copper thus dissolved by the aid also of moderate heat, in the form of nitrate of copper, which, in the event of any small quantity of lead being present, will of course be contaminated with nitrate of lead.

When copper ores are dealt with, which contain above 6 per cent of copper, which may be somewhat judged from the rather larger bulk of the spongy mass of precipitated metal, 16 c.c. of nitric acid, instead of 8, are applied for dissolving the spongy metallic mass. The solution thus obtained is left to cool, and next mixed, immediately before titration with cyanide of potassium, with 10 c.c. of normal solution of liquid ammonia, prepared by diluting 1 volume of liquid ammonia, sp. gr. 0·93, with 2 volumes of distilled water.

In the case of such ores as yield over 6 per cent of copper, and when a double quantity of normal nitric acid has consequently been used, the solution of copper in nitric acid is diluted with water, and made to occupy a bulk of 100 c.c.; this bulk is then exactly divided into two portions of 50 c.c. each, and each of these separately mixed with 10 c.c. of the liquid ammonia solution just alluded to, and the copper therein volumetrically determined. The deep blue-coloured solution of oxide of copper in ammonia only contains besides nitrate of ammonia, any lead which might have been dissolved having been precipitated as hydrated oxide of lead, which does not interfere with the titration with cyanide of potassium. The solution of the last-named salt is so arranged, that 1 c.c. thereof exactly indicates 0·005 grm. of copper. Since, for every assay, 5 grms. of ore have been taken, 1 c.c. of the titration fluid is, according to the following proportion:—

$$5 : 0{\cdot}005 :: 100 : x = 0{\cdot}1,$$

equal to 0·1 per cent of copper; it hence follows that, by multiplying the number of the c.c. of cyanide of potassium solution used to make the blue colour of the copper solution disappear, by 0·1, immediately indicates the percentage of copper contained in the ore.

As may be imagined, at the laboratory of the mine-owners at Eisleben, such a large number of assays are daily executed that, in this case, there can be no reason to fear a deterioration of the cyanide solution, of which large quantities are used and often fresh made; but for security's sake, the solutions are purposely tested for control at least once every week. According to the described plan, six assays can be made within 4 hours; and during a working day of from 7½ to 8 hours, twenty assays have been often made quite satisfactorily by the umpires, as well as the workmen at Eisleben.

* Translated from the original German from the *Zeitschrift fur Analytische Chemie Von Fresenius*, 1869, No. 1.

Some Special Observations on the Volumetrical Estimation of Copper by Means of Cyanide of Potassium, bearing upon the Method just described.

Dr. Steinbeck considered it necessary to test his method specially, in order to see what influence is exercised thereupon by (1) nitrate of ammonia, (2) caustic ammonia, (3) presence of oxide of lead. The copper used to perform the experiments for this purpose was pure metal, obtained by galvanoplastic action, and was ignited to destroy any organic matter which might accidentally adhere to it, and, next, cleaned by placing it in dilute nitric acid. Five grammes of this metal were placed in a litre flask, and dissolved in 266·6 c.c. of normal nitric acid, the flask and contents gently heated, and, after cooling, the contents diluted with water, and thus brought to a bulk of 1000 c.c exactly. Thirty c.c. of this solution were always applied to test and titrate one and the same solution of cyanide of potassium under all circumstances. When 5 grammes of ore, containing on an average 3 per cent of copper, are taken for assay, that quantity of copper is exactly equal to 0·150 gramme of the chemically pure copper. The quantity of normal nitric acid taken to dissolve 5 grammes of pure copper (266·6 c.c.), was purposely so taken, as to correspond with the quantity of 8 c.c. of normal nitric acid which is applied in the assay of the copper obtained from the ore, and this quantity of acid is exactly met with in 30 c.c. of the solution of pure copper.

As regards No. 1 and No. 2 (see above), the influence of double quantities of nitrate of ammonia and free caustic ammonia (the quantity of copper remaining the same), and the action of dilute solution of cyanide of potassium thereupon, will become elucidated by the following facts:—

(*a*). Thirty c.c. of the normal solution of copper, containing exactly 0·150 gramme of copper, were rendered alkaline with 10 c.c. of normal ammonia, and are found to require, for entire decolouration, 29·8 c.c. of cyanide of potassium solution; a second experiment, again with 30 c.c. of normal copper solution, and otherwise under identically the same conditions, required 29·9 c.c. of cyanide solution. The average of the two experiments is 29·85 c.c.

(*b*). When to 30 c.c. of the normal copper solution first 8 c.c. of normal nitric acid are added, and then 20 c.c. of normal ammonia solution, instead of only 8, whereby the quantity of free ammonia and of nitrate of ammonia is made double what it was in the case of the experiments spoken of under *a*, there is required of the very same cyanide solution 30·3 c.c. to produce decolouration. A repetition of the experiment, exactly under the same conditions, gave 30·4 c.c. of the cyanide solution employed; the average of both experiments is, therefore, 30·35 c.c.

The difference between 30·35 and 29·85 is equal to 0·5 c.c., and that figure is therefore the coefficient of the influence of double quantities; and supposing this to happen with the ores in question, it would only be equivalent to 0·05 per cent of metallic copper. It is hence clear that slight aberrations of from 0·1 to 0·5 c.c. in the measuring out of 8 c.c. of normal nitric acid, used to dissolve the spongy copper, and of 10 c.c. of normal ammonia, in order to render that nitric acid copper solution alkaline, is of no consequence whatever for the technical results to be deducted from the assay; it should be, moreover, borne in mind that the quantities of free ammonia and of nitrate of ammonia in the actual assay of ores, for which always a quantity of 5 grammes of ore is taken, varies according to the richness or poverty of the ores in copper; and the quotation of the following results of experiments prove that the influence of these substances is only very slightly felt affecting the accuracy of the results:—

Eight c.c. of the normal nitric acid have been found to contain, by means of a series of experiments, 1·353 grammes of anhydrous nitric acid; and this quantity of acid is exactly neutralised by 7·7 c.c. of normal ammonia solution, which contains 0·6515 gramme of oxide of ammonium; and 10 c.c. of the said normal solution contain 0·846 gramme of oxide of ammonium.

One gramme of metallic copper requires, for complete oxidation, 0·2523 gramme of oxygen, and this quantity of oxygen is given off by 0·5676 gramme of anhydrous nitric acid; while, at the same time, binoxide of nitrogen is disengaged. From these data can be calculated (1) the quantity of nitric acid which becomes decomposed when variable quantities of metallic copper are dissolved therein, (2) what quantity of nitric acid is left to form neutral nitrate of ammonia, and (3) what quantity of free ammonia will be left after a portion of that alkali has been combined with, and therefore neutralised by, oxide of copper, and any remaining free nitric acid. The following figures exhibit these variations:—

From Ores.		From 1·353 grms. of anhydrous nitric acid, equal to 8 c.c. of normal nitric acid,		From 0·846 grm. of NH_4O, as met with in 10 c.c. of normal solution of NH_3, remain capable of forming ammoniacal oxide of copper,
Containing copper.	When 5 grms. were taken for assay, were obtained of copper.	Become decomposed by the dissolution of the copper.	Remain, so as to be capable of forming nitrate of ammonia.	
Per cent.	Grms.	Grms.	Grms.	Grms.
1	0·050	0·028	1·325	0·208
2	0·100	0·056	1·296	0·222
3	0·150	0·085	1·268	0·235
4	0·200	0·113	1·240	0·249
5	0·250	0·142	1·211	0·263
6	0·300	0·170	1·183	0·276

It will be readily seen that the quantitative aberrations between ores containing 1 per cent or 6 per cent of metal, vary very little from the normal quantities exhibited by ores containing 3 per cent of metal. The relation is as 1 : 2; and, for technical purposes, this has been proved not to be a disturbing quantity.

When, however, larger quantities of ammoniacal salts are present in the fluid to be assayed for copper, by means of a titrated solution of cyanide of potassium, and especially when carbonate, sulphate, and, worse still, hydrochlorate, of ammonia are simultaneously present, these salts exert a very disturbing influence, as fully discussed in Fresenius's "Handbook of Analytical Chemistry," to which the reader is therefore referred. The presence of oxide of lead in the copper solution to be assayed has the effect of producing, on the addition of ammonia, 10 c.c. of normal ammonia, a milkiness along with the blue tint; but the presence of this oxide does not at all interfere with the estimation of the copper by means of the cyanide, provided the lead be not in great excess; and a slight milkiness of the solution even promotes the visibility of the approaching end of the operation.

Dr. Steinbeck has, however, purposely made some experiments to test this point, and his results are as follows:—He first prepared a solution of metallic lead in as little nitric acid as possible; and next diluted that solution, so that 1 c.c. thereof contained 0·0075 gramme of lead; with that solution the following experiments were made:—

(*a*). Thirty c.c. of normal copper solution, containing 0·150 gramme of copper, and 10 c.c. of normal ammonia solution, required, for complete decolouration, 29·9 c.c. of solution of cyanide of potassium.

(*b*). Thirty c.c. of the same solution as *a*, and in addition thereto 2 c.c. of solution of lead, containing 0·015 gramme of lead, equal to 10 per cent upon the quantity of copper, required of cyanide solution 30·0 c.c.

(*c*). Thirty c.c., as above under *a*, and addition thereto of 4 c.c. of solution of lead, containing 0·030 gramme of lead, equal to 20 per cent upon the quantity of copper, required of cyanide solution 29·9 c.c.

(*d*). Thirty c.c., again as above under *a*, and addition thereto of 10 c.c. of solution of lead, containing 0·075

gramme of lead, equal to 50 per cent upon the quantity of copper, required of cyanide solution 30·0 c.c.

(*e*). Thirty c.c. of copper solution again, and addition thereto of 20 c.c. of solution of lead, containing 0·15 gramme of lead, equal to 100 per cent upon the quantity of copper, required of cyanide solution 30·1 c.c.

Since neither 50 nor 100 per cent of addition of lead exerts any perceptible influence upon the estimation of copper from its ores, or otherwise, by means of cyanide of potassium, a small quantity of accidentally-occurring lead will not affect the results, and this the less so, as, generally, no ores of both metals occur together, wherein both are met in sufficient quantity to make it worth while working the ore for both metals at the same time.

Since it is well known that the presence of zinc very perceptibly influences the action of a solution of cyanide of potassium, when applied to the volumetrical estimation of copper, Dr. Steinbeck considered it necessary to institute some experiments, in order precisely to ascertain, with what quantity of zinc present along with copper, this influence commences to become perceptible. The solution of zinc applied was made by dissolving the metal in the smallest possible quantity of nitric acid; and 1 c.c. of that solution contained 0·001 gramme of zinc. The results of the experiments recorded in the following tabulated form were made with this solution of zinc:—

Copper Solution.		Normal Ammonia.	Zinc Solution.		Percentage upon Copper.	Solution of Cyanide required.
c.c.	Copper in grms.	c.c.	c.c.	Zinc in grms.		c.c.
30	0·150	10	—	—	—	30·00
30	0·150	10	1·5	0·0015	1	30·00
30	0·150	10	3·0	0·0030	2	30·10
30	0·150	10	4·5	0·0045	3	30·00
30	0·150	10	6·0	0·0060	4	30·00
30	0·150	10	7·5	0·0075	5	30·05
30	0·150	10	10·5	0·0105	7	30·60
30	0·150	10	10·5	0·0105	7	30·60
30	0·150	10	15·0	0·0150	10	30·90
30	0·150	10	22·5	0·0225	15	31·20

The presence of zinc does not interfere with the visibility of the end of the reaction, viz., the decolouration of the copper solution. The results of the experiments herewith quoted prove that a small quantity of zinc, less than five per cent of the quantity of copper present, or 0·0075 gramme by weight of zinc, does not at all affect the action of the solution of cyanide of potassium; but when the quantity of zinc increases, a very perceptible effect is seen upon the solution of cyanide; it is therefore necessary to bestow due care while washing the spongy copper, after it has been precipitated by means of zinc from its solution (see above, under II.).

Since it has been ascertained that the action of solution of cyanide of potassium in researches of this kind is also affected by an increased temperature of the solution of copper which is to be titrated therewith, it is strictly necessary never to operate with warm solutions of ammoniacal copper, but to suffer the same to cool down to the ordinary temperature of the air of the laboratory.

While 30 c.c. of copper solution, containing 0·15 gramme of copper, and 10 c.c. of normal ammonia solution, required, at the ordinary temperature, 30·0 c.c. of cyanide solution; the same quantities required, at between 40° to 45° C., 28·8 c.c. of solution of cyanide; and at 45° C., 28·9 c.c. of the same solution, thus proving the injurious effect of warm solutions.

(To be continued.)

Test for the Genuineness of Chocolate.—M. Reinsch.—(*Pharm. Zeitschr. f. Russland*, No. 2, 1869.)—One part, by weight, of chocolate is ground to powder and mixed with ten times its weight of hot water, the mixture boiled for a minute, next cooled, and then poured on a paper filter. When the chocolate is genuine—that is to say, has not been adulterated with starch, wheaten flour, or starchy matter of any kind—the fluid is not thick, and easily runs through the paper; the filtrate is also clear, and exhibits a light brownish red fluid agreeable to the taste. The reverse is the case with adulterated chocolate.

NOTE ON

THE DISCOVERY OF THE WEIGHT OF THE AIR.

By G. F. RODWELL, F.C.S.

In the last number of this journal, M. l' Abbé Hamy has replied at some length, and with much ingenuity, to certain statements, by which I endeavoured to prove that Aristotle did not discover the weight of air by direct weighing; and I am bound to confess that his further discussion of the subject has not caused me to alter my opinion, the grounds for retaining which will be best indicated by considering the nature of the objections. It is with regret that I differ from M. Hamy, for he has preserved throughout a courteous spirit too rarely to be met with in controversies, and I will here beg him to discover no discourtesy in the following remarks, which are not made in a contentious spirit, or in forgetfulness of his much learning.

M. Hamy commences his animadversions by giving the Greek, Latin, French, and English texts of the disputed passage, in order to show that the word usually rendered *bladder* should be in reality *leather bag* or *bottle*; this I am quite willing to cede: ἀσκὸς (perfectly rendered in the Latin translation by *utrem*, and in the French translation by *outre*) rightly signifies a wine-skin or leather bottle, literally *the skin of an animal*; such skins were not alone used for containing liquids, but were sometimes inflated with air and employed by swimmers and by fishermen; in the British Museum there is a representation, on one of the sculptured blocks of Ancient Assyria, of a fisherman supported in mid stream by an inflated skin. Seeing that the word is ἀσκὸς, it is strange that it should so invariably, both by ancient and modern commentators, be rendered *bladder*, and that Ptolemy the mathematician, and Simplicius, should have repeated the experiment with a bladder; it is to be borne in mind, however, that the latter would always be easier to procure and more convenient for the experiment than a wine-skin, both on account of its greater flaccidity, and because it could be more easily closed air-tight: Mr. G. H. Lewes, an exact and profound scholar, writes as follows, in a discussion of the treatise Περι ουρανου, in, I suppose, the most exhaustive modern work on the scientific knowledge of Aristotle*:—"In other words, everything except fire in its own place, has weight. That even air has weight is proved by the fact that a bladder filled with air is heavier than the same bladder empty."

The main point of M. Hamy's former communication was to show that Aristotle employed, "*not an extensible bladder, but an almost inextensible leathern jar successively full and empty of air.*" He now says—"*Everybody admits that a leathern bottle, whether formed with a skin or consisting of a bladder, constitutes an open extensible vessel, capable, however, of being bent or flattened. Resistance to extension does not, in fact, imply absolute rigidity, and a body can cease to be extended without becoming stiff. It can also be said that a leathern bottle is very slightly extensible, without its meaning rigid. We comprehend, then, that a leathern bottle can receive compressed air.*" Now I say this is an argument in a circle, if ever there was one; it is a sophistry essentially me liæval; a modus of reasoning which reminds me somewhat of the argument of the brazen seal concerning matter and form, in the *Introductio ad Theologiam* of Peter Abelard; in character it appertains more to the theologian than to the man of science; it savours of the Sorbonne rather than of the Lycée Napoleon. "And though," says Master Peter, concerning the brazen seal, "they are essentially the same thing, yet the brazen seal is made of the brass, not the brass of the brazen seal, and the brass is the matter of the brazen seal, not the

* "Aristotle: a Chapter from the History of Science, including Analyses of Aristotle's Scientific Writings," chap 7, p. 142.

seal of the brass," and so on interminably with excessive ingenuity and subtlety. No wonder Abelard was the most brilliant disputant and dialectian of his age; who could answer such an argument off-hand in a public debate, and who could answer off-hand the argument given above about resistance to extension, and the marvellous corollary? This must surely be an example of one of the "useless and illegitimate" moods of the syllogism of which Aristotle writes. Again, if "almost inextensible," how can the leathern bottle be said to be "open and extensible?" The fact is M. Hamy has shifted his ground, and the former arguments rise up and destroy the latter, as the armed men which sprang from the teeth of the dragon slew each other when Jason threw a stone into their midst. I certainly cannot admit that πεφυσημενος ἀσκὸς means either "an almost inextensible leathern jar, or a leathern bottle which, without being rigid, "is very slightly extensible." Πεφυσημενος (φυσαω) clearly signifies *blown out*, or *inflated*, and there is no idea of partial inextensibility in the whole phrase, neither would Aristotle have spoken of a leather bottle full of air (that is already inflated), as κενος, and of the same bottle as πεφυσημενος when air was compressed into it. This is a mere perversion of terms. Whether the receptacle employed were a bladder or a leathern bottle, it was capable of existing in a state of collapse (κενος) and in a state of inflation (πεφυσημενος), and the basis of the experiment described was the causing the receptacle to pass from the former to the latter state, in all probability as Simplicius asserts, by forcing air into it from the lungs.

In M. Hamy's former communication (p. 119 of this volume) he says, "For myself, I believe that the great philosopher, by means of a blowpipe, confined in his leathern jar more air than it would contain at the normal pressure." He now entirely deserts this position, and calls up a *Deus ex machinâ* to account for the filling of the vessel. "Mr. Rodwell," he says, "reasons, in the persuasion which he seems to entertain, that Aristotle would have been obliged to swell the bladder with his own breath." I "reasoned in this persuasion" both because M. Hamy, whose argument I was answering, so reasoned, and further, because one of the most profound and exact of the older commentators of Aristotle likewise gives it as his persuasion. Then comes the *Deus ex machinâ*. "But this supposition is unfounded. Long before the philosopher's time, if Homer is to be believed, the Greek smiths were acquainted with the use of bellows." I may add that long before the time of Homer, the Egyptians were acquainted with bellows; and it is believed that they introduced a valve at least as early as the time of Moses*; and further, as I have elsewhere endeavoured to show,† that bellows were probably invented by the makers of these leathern bottles of which we are speaking. Then as to the question of the balance, if we admit, with M. Hamy, that the ancient Greeks possessed balances capable of weighing minute quantities of gold (of which I believe we have no proof), it would be impossible that a wine skin capable of holding fifteen litres (the size which he assumes), could be weighed by such a balance, neither could compressed air be retained in a vessel of this nature.

Next as to those who repeated the experiment and failed, M. Hamy says, "Ptolemy and Simplicius denied Aristotle's assertion because they did not admit the theoretical explanation of the philosopher;" on the contrary, they were well versed in the writings of Aristotle, and they repeated the experiment with every hope of success. The fact that Averroës (or Ibn-Roschd, as M. Renan‡ prefers to call him) "affirms that he succeeded," I think of but little value, and for the following reasons:—When the Sultan Yakoub-Jossouf requested Ibn-Roschd to compose a commentary on the works of Aristotle, he was probably unaware that he did not understand Greek; the fact being that Ibn-Roschd studied Aristotle through Arabic or Syriac translations, which, in their turn, were made from a Latin translation;* and yet this man was called "*L'ame d'Aristote*," and it was mainly through him, assisted by the University of Cordova, that the Peripatetic dogmas were disseminated, and that the stupendous mass of false philosophy and perverted Aristotelianism, called Scholasticism, arose to fetter the intellect of Europe. Surely Simplicius and Ptolemy ought to be heard before a man who received his knowledge of Aristotle not even at second-hand. At this time, Heloise was one of the very few Greek scholars in Europe. With all respect for the University of Cordova, then the most famous and learned university in Europe, I do not think that the critical knowledge of Greek possessed by it as a whole would have satisfied a Regius Professor of our day.

M. Hamy speaks of Aristotle as "the most exalted genius that human reason, left to its own powers, has produced." While admitting that he was one of the most exalted geniuses which the world has produced, I cannot say that his intellect was "left to its own powers." He was sufficiently wealthy to procure a good library at a time when books were extravagantly expensive, and to these he applied himself so well that he received the name of "the Reader." He was seven years at the court of Macedon, and Alexander the Great, first his pupil, remained his friend, and did all that was possible to further his literary labours; but, above all, for no less than seventeen years Aristotle enjoyed the instruction and the friendship of Plato, the greatest and divinest of Greeks, "the finest of human intellects, exercising boundless dominion over the finest of human languages." No; if ever there was a man who possessed every possible intellectual advantage which his age could furnish, that man was Aristotle.

Having now considered M. Hamy's arguments, little remains to be said. The sentence which has furnished us with this discussion is sufficiently brief:—Εν τῳ αὐτοῦ γαρ χώρᾳ πάντα βάρος ἔχει πλὴν πυρός, καὶ ὁ ἀήρ. Σημεῖον δ' ὅτι ἔλκει πλεῖον ὁ πεφυσημένος ἀσκὸς τοῦ κενοῦ. Looking at it either in its most literal or most paraphrastic form, analysing it, confronting it with collateral evidence, surrounding it with sophistries, applying to it the subtlest forms of argumentation, I yet see not that we can deduce from it the fact that Aristotle discovered the weight of air. Whether he used his own lungs or a pair of bellows to inflate his receptacle matters little; whether that receptacle were a bladder or a leather bottle matters less, but it must needs be shown that the receptacle could contain within it compressed air in sufficient quantity to show a difference of weight when it was weighed in air; that it could be closed securely while containing compressed air; and that no leakage could ensue; finally, that there were balances capable of weighing such bulky things, and at the same time of indicating the slight difference of weight possible under the circumstances. Till this can be demonstrated we must still admit that Galileo made the first accurate and conclusive experiments to demonstrate by direct weighing that the air has weight. It is surprising to find Aristotle designated a good experimentalist; he was indeed an ardent inquirer and a careful observer, but he seldom attempted to examine material facts by a suitable methodical instrument; he lacked even the rudiments of an experimental method; he was insufficiently critical in regard to physical matters. But he was so infinitely great in many respects that, if he had been a great experimentalist, the world would not have regarded him as a

* "Manners and Customs of the Ancient Egyptians," by Sir G. Wilkinson.

† Chemical News for September, 1863.

‡ See his admirable "*Averroës et Averroisme*;" also Figuier's "*Vies des Savants du Moyen Age.*" There is a large collection of MSS. attributed to Ibn-Roschd in the library of El Escorial. Averroës is a Spanish form of the Arabic Ibn-Roschd; it was sometimes spelt Averrhoës or Adveroys; his full Arabic name was Aboulwalid-Mohammed-Ibn-Ahmed-Ibn-Mohammed-Ibn-Roschd. He was born in Cordova, in 1126; died 1198.

* Mr. Lewes has stated the case forcibly in the following sentence:—"The barbarous jargon which the European Schools had to master, when they opened Latin versions of Averroës, may be imagined when it is known that these were Latin translations from a Hebrew version of an Arabic commentary on an Arabic translation of a Syriac version of a Greek text:" that is the original text of Aristotle.—*History of Philosophy*, vol. ii., p. 60.

greater man. Discoveries are rarely born out of due time; when the world is ready for them and the *modus* of its thought capable of assimilating them, then they appear; if they appear out of due course, and fall upon an uncongenial age they die out and are lost. Facts—whether they be social, political, metaphysical, or physical—belong to ages of development, characterised by the conditions of peoples, of civilisation, of mental calibre, and of intellectual activity; and the intellectual activity of an age breaking as a wave upon the shores of humanity, leaves a residue which gradually accumulates, and forms a resting place upon which more advanced phases of thought repose.

PROCEEDINGS OF SOCIETIES.

NEWCASTLE CHEMICAL SOCIETY.

THE concluding meeting of the Society was held on Thursday, the 22nd inst., the President, J. L. BELL, Esq., in the chair.

Dr. LUNGE read an "*Abstract of the Contents of the Annales des Mines, for* 1868."

Mr. BOWMAN read an "*Abstract of M. Caron's Pamphlet, on Magnesia as a Furnace Material.*"

Mr. B. S. PROCTOR read a "*Note on Medicinal Rhubarb.*"

FRENCH ACADEMY OF SCIENCES.

Monday, April 19th, 1869.

AMONG the large number of papers read—some of which do not interest us, being either purely mathematical, astronomical, or belonging to applied mechanics—we meet, in the first place, with a brief note from M. Delaporte concerning the communications made by MM. Cailletet and Berthelot, on the part pressure plays upon some chemical phenomena; since that note is, however, purely theoretical reasoning, not supported by any experiments, and while it, moreover, does not advance our real knowledge about this question at all, the President thought it ought not to be discussed.

M. J. E. PETREQUIN read a short paper "*On the Cerumen contained in the Human Ear.*" This substance had been analysed by Vanquelin, and also many years ago by Berzelius; the recent researches of the author prove that it contains about one-tenth of its weight of water; a fatty substance made up of oleine and stearine; a potassa soap soluble in water and alcohol, insoluble in ether at the ordinary temperature of the air; also another potassa soap, insoluble in alcohol, but soluble in water; lastly, an organic substance insoluble in water, ether, and alcohol, containing, moreover, lime, potassa, and soda.

M. RABACHE proposed, instead of expressing the equivalents of the elements as multiples of the equivalent of hydrogen taken as unity, that the figure should be 0·25, as this would simplify the tables of equivalents.

M. DUMAS observes thereon that the equivalent of potassium is not the multiple of 0·25, or ¼, but of ½, and moreover states that really there is no warrant for any such change at all.

M. SORET communicated that, after having read Professor Tyndall's note "On the Clouds," he had felt induced to examine, by means of the polariscope, the beautifully blue colour exhibited by many parts of the lake of Geneva, and he stated that this colour was due to the presence of solid particles in the water and of the same specific gravity as that fluid; but he does not say what these particles are nor what size or shape they have, promising, however, further researches.

M. DUBRUNFAUT stated as the conclusion he has been brought to by a series of researches on supersaturation, solution, and superfusion, that the molecular constitution of dissolved substances is different from that which the same substance exhibits when crystallised.

M. DUMAS performed, at this meeting, the following experiment in order to illustrate the paper "On the Action of Heat upon the Peroxide Salts of Iron," by M. Debray:—In a large portion of distilled water some few drops of a *neutral* solution of chloride of iron are poured, care being taken not to apply so much of the salt that its colour is at all imparted to the water; on heating the liquid gradually up to, and above, 70° C., it becomes perceptibly brown-coloured. When that moment has arrived, the water no longer contains chloride of iron, but instead a mixture of free hydrochloric acid and free peroxide of iron; the limpidity of the fluid is not, however, at all impaired. In order to prove this, it is only requisite to pour into the fluid a solution of common salt, whereby the static equilibrium, of the liquid is disturbed and the oxide of iron precipitated. When the experiment is made in sealed tubes, and the latter heated to between 200° and 300° C., crystalline oxide of iron is precipitated.

MM. FRIEDEL and LADENBURG sent a paper on the preparation and properties of a compound which only differs from oxalic acid by the substitution of silicium for the carbon of the acid just named. We intend to return to this paper, and also to publish the interesting papers on the areometer of Baumé, by M. Baudin, and that on the essence of sassafras, by M. Grimaux.

M. MAUMENE communicated some further researches made by him "*On the Action of Potassium upon Dutch Liquid*," the result of which is that, when the metal is in excess, three gases are given off, but when the liquid is in excess, only one of these appears, while the two others remain in solution.

MM. CHAPELAS-COULVIER-GRAVIER, E. ROBERT, and TREMESCHINI described at this meeting the brilliant aurora borealis seen at Paris on the night of the 15th inst., from a quarter past nine until about eleven o'clock; the phenomenon was remarkably developed, completely occupying the N.E. to the W.N.W. portion of the sky. It appears that not only the very sensitive magnetic instruments at the observatory, but even those at the telegraph stations, were perceptibly disturbed.

CORRESPONDENCE.

EQUIVALENCE AND QUANTIVALENCE.

To the Editor of the Chemical News.

SIR,—In your report of the last meeting of the Chemical Society appear some valuable remarks of the President, Dr. Williamson, on the injurious confusion which is introduced into chemical science by the indeterminate significance, and interchangeable use, of the two words *atomicity* and *equivalence*. Dr. Williamson deprecated the shifting and uncertain sense which had been attached to these expressions by various speakers during the evening's debate. He also demurred to the introduction of such words as "bond" to express the function or property in virtue of which chemical compounds are held together. "He would not," he added (according to your report), "express any opinion as to whether the *atomicity* theory was right, or the *equivalence* theory, but they were different."

While humbly supporting with my entire concurrence the earlier part of the learned President's observations, I would venture, with deference, to submit that, into his las

above-quoted phrase, there seem to have crept some traces of that vagueness which he himself so earnestly deplores. Let me, however, hasten, in fairness, to say that the phrase, as reported, wears the aspect of an abridgment, in which the full sense of the speaker's words may have suffered by compression; so that it should be only after revision by Dr. Williamson himself that the report should be taken to convey his precise meaning.

With this reservation, I take the phrase as it stands in your columns, and ask permission, in the interests of neo-chemistry, respectfully to point out that, in referring to atomicity and equivalence as opposed theories, standing in such mutual antagonism as to comport the expression of an opinion "whether one or the other be right" the speaker seems to have been betrayed (doubtless by the haste of improvisation) into a temporary oblivion of well-known and momentous laws.

Those laws, and the most suitable forms for their expression, it devolved upon me to study with the utmost care, during my collaboration with Dr. Hofmann in his "Introduction to Modern Chemistry," and especially while writing the philosophical chapters of that work; a duty which, owing to the illustrious Professor's many and pressing engagements at the time, had, in a great measure, to be entrusted to my inferior hand.

If, therefore, it be opportune, during the prevalence of the unsettled opinions exemplified above, to submit for consideration statements of those laws, in terms at least free from vagueness, whether otherwise admissible or not, I hope that my intervention to fulfil this duty will not, under the circumstances mentioned above, be deemed unduly obtrusive.

Thus much explained, and audience taken as therefore granted me, I strike at once into the heart of the subject, by offering, in the concisest language at my command, exact definitions of *equivalence* and *atomicity*; or, as I prefer to term the latter, *quantivalence*.

To prepare the mind for grasping these definitions, I would first observe that the former expression, *equivalence*, is essentially *ponderal*, and is the answer (so to speak) made by each kind of matter to the question *How much?* while the latter expression, *quantivalence*, is essentially of *numerical* significance, and is the reply of each kind of matter to the experimentalist's question, *How many?*

This preliminary indication shows us, at once, that there is no such antagonism between these two aspects of chemical enquiry as Professor Williamson (if correctly reported) was led at the moment to suppose; that it is not necessary to enquire "whether one or the other theory be right," but that, on the contrary, both views may be true —nay, not only *may*, but *must* be true, seeing that they are but the separate expressions of co-existent and co-relative *facts*.

The *fact*, of which equivalence is the expression, is the reply which a material element makes, from the pan of the balance, to the question propounded in the retort or crucible—*How much of you, by weight, is the minimum quantity, relatively to an assumed standard-unit* (H = 1), *requisite to take part in the formation of a compound molecule?*

To this clear question chlorine as clearly replies, 35·5; oxygen answers, 16; nitrogen, 14; carbon, 12; and so on throughout the elemental list.

The *fact* which *quantivalence* (somewhat barbarously called also atomicity) purports to express, is the reply made by an element, to the analytic and synthetic interrogation:—*How many standard atoms* (H = 1) *is your minimum molecule-forming weight, or equivalent weight, above defined, capable of fixing, to form a compound molecule, or of replacing, in a compound molecule already formed?*

To this distinct question (How many?), chlorine distinctly answers 1; the reply of oxygen is 2; of nitrogen, 3; of carbon, 4; and these numbers, written small, each against the name of the respective element (represented by its initial), denote the respective *co-efficients of quantivalence*. Instead of numerals, dashes, in appropriate number, are frequently used to signify these co-efficients, which conspicuously stamp on each element's symbol its relative atom-fixing and atom-replacing power, or (if I may so express the fact) its chemical *value in exchange*.

These quantivalential co-efficients find their most convenient *spoken* enunciation in the Latin numerical prefixes—*uni*, *bi*, *tri*, and the like. Thus: we call chlorine *uni*valent, and write it $Cl^{i.}$ or Cl′; oxygen, we term *bi*valent, and write it $O^{ii.}$ or O″; nitrogen we denominate *tri*valent, and write it $N^{iii.}$ or N‴; while carbon is designated *quadri*valent, and written $C^{iv.}$ or C⁗.

Turning to the phenomena themselves, which afford us this distinct information, we find in equal volumes of hydrochloric acid, water, ammonia, and marsh-gas (all, of course, taken in the vaporised or gaseous condition), the constituents Cl, O, N, and C, in the proportions due to their respective equivalent weights—35·5, 16, 14, and 12; while, upon counting the standard atoms (H = 1) in each compound, we find 1 in the first-named (HCl), 2 in the second (H_2O), 3 in the third (H_3N), and 4 in the fourth (H_4C).

By writing into these formulæ the respective co-efficients of quantivalence of the elements engaged, the balance of the forces in play, or, as I have ventured to call it, their *quantivalential equilibrium*, is beautifully shown; thus we have—

$$H_1Cl^{i.},\ H_2O^{ii.},\ H_3N^{iii.},\ \text{and}\ H_4C^{iv.}.$$

It is remarkable that the numerical quantivalence of the elements varies quite irrespectively of their ponderal equivalence, or relative combining weights; the combining weights in the series above, for example, happening to diminish progressively, whilst the atom-fixing powers, on the contrary, increase, thus:—

Cl = 35·5	fixes	one atom	only of H.
O = 16	,,	two atoms	,,
N = 14	,,	three ,,	,,
C = 12	,,	four ,,	,,

These higher and lower *numerical* relations, or attractions, of the elements, are, nevertheless, to be carefully distinguished from the gradations, more or less intense, of their *chemical* activity, or (if I may so say) from the *specific chemism* of each. For example, the one atom of hydrogen which *uni*valent chlorine fixes, may (and does) happen to be held with much more force than that which carbon, albeit quadrivalent, puts forth in grasping its four-fold complement of atoms. And so, again, to illustrate the point in another way, though potassium and hydrogen are both but univalent bodies, yet the former (K) by reason of its superior *specific chemism* for oxygen, takes oxygen from the latter (H) with explosive rapidity and force.

It is not, however, my present business to dilate on the beauty or to develope the conditions of these marvellous endowments of material bodies, so much better known to those I address than to myself. The strict limits I have here to observe extend only to the clearing up of certain prevalent misconceptions as to the precise import of the terms *equivalence* and *quantivalence*; as also of the latter's derivatives—*univalent*, *bivalent*, *trivalent*, *quadrivalent*, *multivalent*, and the like; derivatives, let me add, *passsim*, of more classical construction than such hybrid terms as *monovalent*, *polyvalent*, &c., formed by the intermingling of Latin and Greek, and which I regret to see so often employed.

As for the alternative expression, *atomicity*, its meaning, as marked by its derivation, seems to be "indivisibility;" a meaning altogether inappropriate, otherwise than by a purely arbitrary convention, to express the idea of chemical value in exchange, which quantivalence, on the contrary, aptly denotes. Atomicity is, indeed, a weak neologism into which chemists seem to have drifted, for want of a better word, at the time when chemical philosophy was beginning to undergo its great modern trans-

formation. Let us hope that so defective a term may soon give place, by common consent, to the more significant and appropriate term *quantivalence*.

Let us, in conclusion, also hope that between these two terms, *equivalence* and *quantivalence*, as well as between the great laws they imply, all ambiguity and confusion may henceforth cease.—I am, &c.,

F. O. Ward.

London, April 25th, 1869.

MISCELLANEOUS.

The Royal Society.—The following is the list of the gentlemen who have been selected by the Council for election into the Royal Society this year:—Sir Samuel White Baker, M.A., eminently distinguished as a geographer and explorer of distant lands; John J. Bigsby, M.D., distinguished as a geologist and palæontologist; M. Charles Chambers, director of the Colaba Observatory, Bombay; Mr. William Esson, M.A., of Merton College, Oxford; Mr. George Carey Foster, B.A., Professor of Physics in, and Fellow of, University College, London; William W. Gull, M.D., London, distinguished as a physician and as a teacher of the medical sciences; Mr. J. Norman Lockyer, distinguished as an astronomer; Mr. John Robinson M'Clean, C.E., late President of the Institution of Civil Engineers; Mr. St. George Mivart, Lecturer on Comparative Anatomy at St. Mary's Hospital; John Russell Reynolds, M.D., Professor of Clinical Medicine in University College, London; Vice-Admiral Sir Robert S. Robinson, K.C.B., Controller of the Navy; Major James F. Tennant, R.E., late astronomer at Madras; Wyville Thomson, LL.D., Professor of Zoology, Botany, and Geology in Queen's College, Belfast; Colonel H. E. Landor Thuillier, R.A., eminent as an Indian geographer; and Mr. Edward Walker, M.A., distinguished for his mathematical and literary attainments.

"Previous Sewage Contamination."—A discussion is going on at the meetings of the Metropolitan Association of Medical Officers of Health on the subject of "Contamination of Potable Water by Sewage," and the following are questions, having especial reference to *rivers*, on which information is desired:—

Supposing town sewage, discharge of water-closets, &c., to be poured into a running stream, does it undergo oxidation, so that its noxious qualities are lost, and the water restored to a wholesome state? Can you give any instances showing what distance of run in a river will suffice to purify water contaminated with a certain bulk of sewage? Admitting that exposure to sun and air during a run of a certain number of miles in a river will suffice to oxidise dead and decomposing matter, yet there is the hypothesis that *living* matter (*germinal matter*, shapeless organic matter, or germs, cells, or spores of fungi, ova of parasites, &c.,) proceeding from diseased bodies, may be conveyed by river water, and be the cause of disease. Have you any facts showing that disease of any sort has been propagated by such living matter, after a flow of a certain number of miles down a river? Of two towns on the same river—one above draining into it, the other below drinking from it—do you know any instances of disease propagated from the former to the latter through the medium of the river water? Do you know any facts showing the propagation of typhoid, or scarlet fever, through potable water?

An adjourned meeting of the Association will be held on Saturday, May 1st, when the discussion will be resumed on Dr. Letheby's paper "On the Methods of Estimating Nitrogenous Matters in Potable Waters, and on the Value of the Expression '*Previous Sewage Contamination*' as used by the Registrar-General in his Monthly Reports of the Metropolitan Waters."

The chief points for consideration in the paper are the following:—1st. Whether rivers fouled by sewage and manufacturing refuse have or have not a self-purifying power. 2nd. Whether the nitrogenous compounds of river and well waters must necessarily have a previous sewage or manure origin. 3rd. Whether, in describing the analytical facts of water examinations, it is proper to use such a speculative phrase as "Previous Sewage Contamination," and to express the result in tons.

Royal Society.—At the President's second soirée, at the Royal Society, on April 24th, 1869, Mr. John Browning, of the Minories, exhibited the following novel instruments:—

New Electric Lamp, in which both carbons are moved by the electricity without clockwork.

New Polarising Saccharometer, proposed by Dr. Dupré. This instrument shows the amount of sugar in a solution by a change in the position of a line in the spectrum.

An improved Spectroscope, in which the dispersion may be instantly doubled, or trebled, without changing any of the adjustments.

A new Direct Vision Pocket Spectroscope; containing seven prisms, and an achromatic lens. This instrument will show the absorption bands in coloured fluids, the bright lines in the spectra of metals and gases, and all the principal lines in the solar spectrum.

Professor Graham's discovery, the absorption of hydrogen by palladium; a very compact apparatus for showing the expansion of a piece of palladium by the absorption of the gas, contrived by Mr. Chandler Roberts and Mr. John Browning.

The Zirconia Light.—I learn that the oxyhydrogen zirconia light has been such a success at the Tuilleries, having been worked without interruption since the 21st of January, that the Emperor has ordered measures to be take to render that mode of illumination permanent in front of his palace. During the interval required for getting these new arrangements ready, the court will be lit up with ordinary gas as before. In connection with this fact, M. Tessié du Mothay has had the Order of Chevalier of the Legion of Honour bestowed upon him, and well has he merited it for his many useful and practical inventions. Whether the process introduced by this gentleman for the commercial manufacture of oxygen from the manganates is the best that can be used for the purpose may, perhaps, be open to discussion; this, at any rate, is true, that it is the only process that has succeeded on a large practical scale up to the present time. —*British Journal of Photography*.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Analysis of the Celebrated Aventurin Glass made at Venice.—Dr. Salvieti.—(*Pharm. Zeitschr. f. Russland*, No. 2, 1869.)—In 100 parts:—Silica, 67·3; alumina, 9·0; peroxide of iron, 3·4; oxide of tin, 2·3; oxide of lead, 1·0; metallic copper, 4·0; potassa, 5·3; soda, 7·0.

On the Solubility of Iodine and Sulphur in Petroleum.—Dr. Th. Koller.—(*Neues Jahrb. f. Pharm.*, vol. xxxi., No. 2, 1869.)—One part of iodine requires for its solution, at a temperature of 17° C., 145·6 parts of petroleum, and 1 part of sulphur (as so-called flowers sulphur), requires at the same temperature 158·4 parts of petroleum.

Curiously-Petrified Wood.—(*Journ. f. Prak. Chem. v. Erdmann*, No. 1, 1869.)—Dr. Oudemans, jun., has had the opportunity of analysing some pieces of wood from the *Colbertia ovata*, a tree indigenous to Java, which wood, on being placed in a certain stream in that island, becomes rapidly and thoroughly petrified, so as hardly to be distinguishable from sandstone; but microscopic research detects the organic structure. The air-dried wood leaves 1·9 per cent of ash of the following composition in 100 parts:—Silica, 58·8; phosphoric acid, 1·8; carbonic acid, 8·6; oxide of iron, 1·5; alumina, trace; oxide of manganese, 0·1; lime, 12·8; magnesia, 2·7; potassa, 11·3; soda, 1·8. The petrified wood was composed of—silica, 98·0; phosphoric acid, oxide of iron, and alumina, together, 1·3; lime, a trace; organic matter and water, 0·7. It is not quite possible to explain what causes this curious change, unless there were an opportunity to obtain and analyse the water, wherein the petrifying process goes on (as is said by the natives) very rapidly.

Analysis of Smalt.—(*Journ. f. Prak. Chem. v. Erdmann*, No. 1, 1869.)—Under this name is known a blue pigment largely used on the Continent; the sample, of which the result of analysis is here quoted, was as beautiful as best artificial ultramarine. In 100 parts:—Silica, 63·7; oxide of lead, 2·7; protoxide of cobalt, 5·7; potassa, 20·1; alumina, 4·0; oxide of iron, 1·3; water, 1·7. Not a trace of protoxide of nickel was found.

On an Alloy of Iron and Zinc.—(*Journ. f. Prak. Chem. v. Erdmann*, No. 1, 1869.)—It is a well-known fact that iron is dissolved by molten zinc, but nowhere is any definite alloy of these metals described, nor is it also stated how much iron is dissolved by zinc. Dr. Oudemans, jun., obtained for analysis a piece of metal which had been formed in an iron vessel wherein zinc had been fused for several weeks continually; this metal was found deposited at the bottom of the vessel, and became an impediment to the melting operations in consequence of the relative infusibility of the alloy. In physical aspect this latter was of very much whiter colour, and entirely different crystalline structure than zinc; the alloy dissolved very readily and briskly in dilute sulphuric or hydrochloric acid, and was found, on analysis, to contain 4·6 per cent of iron. Taking for granted that this alloy is a definite compound of the two constituent metals, its formula would be—

$$FeZn_{36}\ (Fe=56;\ Zn\ 32{\cdot}75).$$

Analysis of Two Kinds of Labradorite.—(*Journ. f. Prak. Chem. v. Erdmann*, No. 1, 1869.)—Dr. Oudemans, jun., analysed two varieties of this mineral—one violet-coloured, the other white and non-transparent. Violet variety in 100 parts:—Silica, 56·21; alumina, 29·19; oxide of iron, 1·31; lime, 11·14; magnesia, 0·51; soda, 1·37; potassa, a trace; loss on ignition, a trace; total, 99·73. White variety in 100 parts:—Silica, 58·1; oxide of iron and alumina, 27·9; lime, 9·4; magnesia, a trace; soda, 5·1; total, 100·5.

Researches on some Derivatives from Cinnamic Acid.—C. Glaser.—(*Zeitschr. f. Chem. v. Beilstein, &c.*, vol. xii., No. 4, 1869.)—The author has, in a former notice, spoken of an acid containing H_2 less than cinnamic acid; that acid has been called by him phenylpropiolic acid, the constitution of which is represented by—

$$C_6H_5C$$
$$\|$$
$$C$$
$$|$$
$$CO_2H.$$

The author further states that, by taking CO_2 from this acid, he would be enabled to form a new hydrocarbon, which would stand in the same relation to acetylen as styrol stands to ethylen. This new hydrocarbon is named acetenylbenzol; this material is a colourless highly refrangible fluid, having a peculiar odour, and boiling at 140°; vapour density, 3·7; formula, C_8H_6. It is readily decomposed by nitric and sulphuric acids. It combines with copper, forming a compound—

$$[C_6H_5C_2]2Cu+CuO.$$

Bromophthalic and Nitrophthalic Acids.—Faust.—(*Zeitschr. f. Chem. v. Beilstein, &c.*, vol. xii., No. 4, 1869.)—The author prepared, for some other researches, bromo and nitrophthalic acids. The former is represented by—

$$C_8H_5BrO_8.$$

In the pure state it is a white crystalline powder readily soluble in water, alcohol, and ether, and fuses between 136° and 138° C., without giving off vapour of water; it forms salts with bases. Nitrophthalic acid—

$$C_8H_5(NO_2)O_4,$$

is obtained when phthalic acid is digested with a mixture of equal parts of red fuming nitric acid and sulphuric acid; the mixture is left for twenty-four hours to itself, and then treated with water and purified by making a potash salt of the newly-formed acid, and this is decomposed by means of sulphuric acid. Nitrophthalic acid crystallises from ether in straw-yellow prisms, is soluble in water and ether, and fuses at 208° C. This acid also forms salts very readily.

Mono- Tri- and Penta-bromo-benzoic Acid.—Reinecke.—(*Zeitschr. f. Chem. v. Beilstein, &c.*, vol. xii., No. 4, 1869.)—When bromine acts upon benzoic acid, water being present and a higher temperature applied, the above-named bromo-benzoic acids are obtained. The mono-bromic acid—

$$C_7H_5BrO_2,$$

is difficultly soluble in water, crystallises, and fuses at 152° C.; the tri-bromo-benzoic acid—

$$C_7H_3Br_3O_2,$$

is also a solid crystalline substance, hardly soluble in boiling water, and fuses at 235° C.; the penta-bromo-benzoic acid—

$$C_7HBr_5O_2,$$

is also a solid, soluble (as are also the two preceding) in weak alcohol, and fuses at the same temperature as the tri-bromo-benzoic acid. All these acids readily enter into combination with lime, forming regular and well-defined salts.

Results of Analyses of Compressed Peat from Switzerland.—Dr. Goppelsroeder.—(*Chem. Centralbl.*, No. 11, 1869.)—The air-dried substance contained in 100 parts:—Water, 23·17; ash, 7·87; carbon, 40·09; hydrogen, 4·53; oxygen, 21·50; nitrogen, 2·84. The material submitted to elementary organic analysis had been dried at 120° C. The ash contained chiefly sulphuric acid, lime, alumina, peroxide of iron, and silica; also chlorine, soda, magnesia, and traces only of phosphoric acid.

On the Lowering of Temperature due to the Solution of Salts in Water.—Fr. Rüdorff.—(*Berichte d. Deutschen Chem. Gesellsch. z. Berlin*, No. 4, 1869.)—The decrease of temperature will be the greater the larger the quantity of any salt which water takes up at a certain given temperature. Since, however, water at a certain temperature only dissolves a definite quantity of any salt, the maximum decrease of temperature will be about that at which, under given circumstances, a fully saturated solution is produced. When, therefore, the salt and the water are applied in the proportion wherefrom a saturated solution results, a long period of time elapses before the last portions of the salt are entirely dissolved, and the effect of the warm ambient air to some extent vitiates the proper results of the experiments; the saturated solution should therefore be obtained as rapidly as possible. The experiments were conducted in the following manner:—The finely-powdered salt and the requisite quantities of water were, previous to the making of the experiments, each put in separate beakers made of very thin glass, and placed for from 12 to 18 hours in a room wherein the temperature could be kept as nearly as possible constant; in consequence of this the beakers and contents attained the same temperature throughout. The mixing was effected by pouring the water on to the salt, and stirring up with a very delicate and highly-sensitive thermometer; the maximum decrease of temperature took place within a minute after the mixing of the salt and water was made. The results of the experiments are exhibited in the following tabulated form, recording the average of a series of several experiments with one and the same substance, which were concordant within 0·2°:—

	Soluble in 100 parts of water.	Mixed with 100 parts of water.	The temperature falls From °C	The temperature falls To °C.	Number of Degrees. °C.
Crystallised alum ..	10·0	14	+10·8	+ 9·4	1·4
Chloride of sodium	35·8	36	12·6	+10·1	2·5
Sulphate of potassa	9·9	12	14·7	+11·7	3·0
Crystallised phosphate of soda ..	9·0	14	10·8	+ 7·1	3·7
Sulphate of ammonia	72·3	75	13·2	+ 6·8	6·4
Sulphate of soda (crystals)	16·8	20	12·5	+ 5·7	6·8
Sulphate of magnesia (crystals) ..	80·0	85	11·1	+ 3·1	8·0
Carbonate of soda (crystals)	30.0	40	10·7	+ 1·6	9·1
Nitrate of potassa..	15·5	16	13·2	+ 3·0	10·2
Chloride of potassium	28·6	30	13·2	+ 0·6	12·6
Carbonate of ammonia	25·0	30	15·3	+ 3·2	12·1
Acetate of soda (crystals)	80·0	85	10·7	− 4·7	15·4
Chloride of ammonium	28·2	30	13·3	− 5·1	18·4
Nitrate of soda ..	69·0	75	13·2	− 5·3	18·5
Hyposulphite of soda (crystals)	98·0	110	10·7	− 8·0	18·7
Iodide of potassium	120·0	140	10·8	−11·7	22·5
Chloride of calcium (crystallised) ..	200·0	250	10·8	−12·4	23·2
Nitrate of ammonia	55·0	60	13·6	−13·6	27·2
Sulphocyanide of ammonium	105·0	133	13·2	−18·0	31·2
Sulphocyanide of potassium	130·0	150	10·8	−23·7	34·5

The quantity of water applied varied between 250 and 500 grammes, and the quantity of salt used corresponded therewith. The decrease of temperature obtainable in this manner can never fall below the freezing point of the saline solution in question, but can very nearly reach that. The sulphocyanide of potassium is the best salt to be adopted for the artificial production of ice; when 500 grammes of this salt are dissolved in 400 cubic centimetres of water, and the mixture stirred with a test-tube filled with water, the latter will be frozen in from two to three minutes. The degree of solubility of the salts referred to in the first column is made up according to G. J. Mulder's highly elaborate researches on this subject.

On Mesitylen.—(*Journ. f. Prak. Chem. v. Erdmann*, No. 1, 1869.)—This is best prepared from aceton, by allowing it to be left first for twenty-four hours in contact with sulphuric acid diluted with half its bulk of water, and proceeding to the distillation of the mixture; after that time, in this manner a larger quantity of raw produce is obtained, which is next rectified by distillation over sodium. Treated with strong nitric acid, mesitylenic acid is produced, which forms, with bases, well-defined salts. Among the products of oxidation of mesitylen belong uvitinic acid and trimesinic acid, while mesidinic acid is an intermediate product. The following formulæ refer to these products, mesidinic and uvitinic acids being proved to be identical; the formula for the latter refers to the latter also:—

Mesitylen.	Mesitylenic acid.	Uvitinic acid.	Trimesinic acid.
C_9H_{12}.	$C_9H_{10}O_2$.	$C_9H_8O_4$.	$C_9H_6O_6$.

Uvitinic acid is a solid substance, difficultly soluble even in boiling water, but readily so in alcohol and ether; it fuses at 288° C., sublimes without decomposition, and is a bibasic acid which readily forms salts with bases. Trimesinic acid, when distilled with excess of lime, yields chiefly benzol—

$$C_9H_6O_6-3CO_2=C_6H_6;$$

this acid is consequently a benzol wherein for 3H has been substituted 3COHO.

Obtaining Coke quite free from Sulphur.—(*Moniteur de l'Indre France.*)—The coke made in the usual manner is placed in an apparatus wherein it is heated at a temperature of about 300° C., and simultaneously submitted to the action of a strong current of atmospheric air compressed to between two and three atmospheres (30 to 45 lbs. to the square inch). By this means the sulphur is converted into sulphurous acid, and that gas removed by the strong current of air. Analysis of coke, before and after having been submitted to this process, proves:—(*a*) Not a trace of sulphur is left in any form in the coke submitted to the described treatment; (*b*) all the iron previously existing in the coke as sulphide has been converted into peroxide; (*c*) the calorific power of the desulphurised coke has become greatly increased, and is at least one-fourth more than that of ordinary coke; (*d*) experiments conducted on the large scale at iron works have proved that the coke treated as described produces iron as good in quality as that obtained with wood charcoal.

Preparation of Uric Acid from Peruvian Guano.—Dr. J. Löwe.—(*Les Mondes*, No. 14, 1869.)—In order to prepare uric acid from this material on the large scale, take equal weights of sulphuric acid and guano; heat the sulphuric acid in a porcelain basin placed on a water-bath, put the previously well-dried and ground-up guano, dried at 100° C., little by little into the acid, taking care to stir up the mixture with a glass rod, since during this operation much carbonic acid and hydrochloric acid gas are given off. It is necessary to perform the operation either in the open air or under a chimney hood with a good draught; as soon as the reaction ceases, dilute with from ten to twelve times its bulk of distilled water. A yellow precipitate soon ensues, and it is therefore preferable to perform the dilution, not in a basin, but in a cylinder glass. The precipitate having settled, the supernatant liquid is decanted, the precipitate first washed by decantation, and afterwards collected on a filter and washed until the sulphuric acid is nearly all removed; the precipitate is then, little by little, added to a boiling weak alkaline solution, and the uric acid precipitated from the alkaline fluid by means of hydrochloric acid. The crude uric acid thus obtained is purified by the processes of either Wöhler or Heintz.

On the Action of Penta-Chloride of Phosphorus upon Saccharine Substances.—A. Baeyer.—(*Berichte d. Deutschen Chem. Gesellsch. z. Berlin*, No. 3, 1869.—When grape sugar is boiled with a mixture of penta-chloride of phosphorus, oxychloride of phosphorus, and water, an amorphous, colourless, flocculent matter is formed, which dissolves in water on boiling; this indicates either the formation of an anhydrous substance or of a chloride; since, however, the sugar is, while being thus treated, readily decomposed, and this decomposition accompanied with a brownish colouration, the reaction cannot be satisfactorily studied. Cotton wool behaves, when treated with the same substances, in a similar manner; when gun cotton, however, is heated up to 200° C. in a mixture consisting of six parts of pentachloride of phosphorus and some oxychloride of phosphorus, the gun cotton is entirely dissolved in the latter substance without any decomposition. When the oxychloride and pentachloride of phosphorus are dissipated by evaporation by means of a current of air heated to 170° C., there is left a thick colourless liquid which, on cooling, leaves a brittle gum-like mass; this substance is soluble in ether and alcohol, and insoluble in water, but on being boiled therewith decomposition ensues and a viscous substance remains. When the gum-like mass is treated with solution of caustic potassa, and heated therewith, it becomes brown; on being heated with hydriodic acid, iodine is separated. The substance in question appears to be a chloride of cellulose or of sugar, somewhat resembling the chlorides of mannite.

NOTES AND QUERIES.

Aluminium Bells.—It appears that some Belgian manufacturer has just had a bell cast of aluminium, and with very good results. It is of course extremely light, so that, though large, it can be easily tolled; its tone is reported to be loud and of excellent pitch. Aluminium is the most sonorous of all metals.—*Engineer.*

Carbonic Acid.—Do you see any objection to common washing soda as a source of carbonic acid? I have used it now for years, and find it a very great convenience. There is a total absence of fumes, as I use sulphuric acid and water; there is an abundant supply of gas, and, above all, there is very rapid production, so desirable in class experiments. Still, as none of "the books" mention it, I hesitate to teach that soda is a better carbonate to use than marble or chalk. In one of his Christmas lectures (CHEMICAL NEWS, xix., 101), Dr. Odling coloured the gas brown. How is that to be done?—E. KERNAN.

"How to Prevent the Spread of Scarlet Fever."—A few weeks ago, some suggestions on the above subject appeared in a medical paper, and were reprinted in a leading journal; the idea of the writer was that the plentiful use of "green copperas" as a disinfectant, would prevent the spread of fever; the germs of which, from the drains, often penetrate into the wells and contaminate the drinking water. Allow me to ask a question, with reference to the plan above stated. This disinfectant is, I believe, a poison; and is there not danger from its infecting the water? If so, the remedy would be as bad as the evil that is sought to be cured. I throw out the hint, only suggesting the question for discussion, and not pretending to give any opinion upon it: it is a matter, however, well worthy the attention of your readers.—SANITAS.

Mutual Decomposition.—Analysis of Sewage.—About forty years ago, researches were made concerning the first part of this query by Dr. G. J. Mulder. The printed memoir containing the result of these researches is out of print. But the precise answer to this some what complicated subject, depends on the conditions under which the salts are brought together; also, whether or not organic matter is present. The presence of the silicate of alumina, and of the peroxide of iron, has very little, if any, influence at all. There are plenty of excellent treatises on analytical chemistry, published in various languages, the titles of which "W." may be informed of by any bookseller. There is no necessity to specify any of these books in our pages.

Safety Matches.—It is well known that serious accidents occur from fire, caused by persons carelessly throwing down matches, which they believe to be harmless because the flame has been extinguished, but which, in reality, are highly dangerous, and quite capable of communicating fire to any light, dry material, in consequence of the wood splint being at a red heat, although not actually in flame. It has been proposed, in order to prevent this, to saturate the splints, previously to their being dipped, with a solution of some chemical salt which has the property of preventing the wood from remaining at a red heat after the flame has been extinguished, without being in any way detrimental to the inflammable nature of the splint, and thus to prevent the possibility of accident from the dropping of the match after the extinction of the flame, but while the splint is still at a red heat. The substance which it is proposed to employ is alum, though other salts have the same property. The matches, before being dipped, are to be immersed in a strong solution of alum, or other salt with similar action, until they are saturated; they are then to be dried and tipped with the ordinary composition. Matches, so treated, are said to ignite and burn with flame as long and as readily as other matches; but the instant the flame is blown out the match becomes black and perfectly harmless.—*Scientific American.*

On Luteine and the Spectra of some Yellow Organic Substances.—By luteine, Dr. Thudicum understands a yellow crystalline substance occurring in various parts of animals and plants, as, for instance, the *corpora lutea* of ovaries, serum of blood, yolks of eggs, in seeds, as maize (Indian corn), in annatto, in carrots, and the stamina and petals of a great many flowers. Luteine is easily soluble in alcohol, ether, and chloroform, insoluble in water; these solutions are yellow, but that in chloroform, when concentrated, has an orange-red colour. Spectrum of solutions is distinguished by great brilliancy of the red, yellow, and green part, and by three absorption bands, which are situated in the blue, indigo, and violet part of the spectrum. The crystals of luteine are apparently rhombic plates, of which two or more are always superposed in a curious manner. The crystals are microscopic, yellow when thin, orange to red when thick, and have no resemblance to any other known animal or vegetable substance. Luteine combines with few substances, mercury-acetate being, perhaps, the only reagent by which it is immediately and completely precipitated as a yellow deposit; mercury-nitrate produces a yellow precipitate which, on standing, becomes white. Nitric acid poured over the crystals, produces a blue colour, which immediately passes into yellow. The blue is not produced when nitric acid is added to either the alcoholic, ethereal, or chloroformic solution of luteine, but appears with the acetic acid solution and disappears again rapidly Luteine has great affinity for fatty matters and for albumine.

Sulphide of Carbon Light.—Mr. D. Winstanley describes (in the *British Journal of Photography*) an apparatus consisting of a water-bath heated by a Bunsen gas burner; within the water-bath is placed a vessel, to hold disulphide of carbon. The outer and inner vessels are firmly soldered together, and proper arrangements are made to enable the experimenter to pour water in the outer vessel, which is also provided with a neck to hold a thermometer, serving to indicate when the temperature at which the bisulphide of carbon contained in the inner vessel boils. The inner vessel is provided with a neck, closed by a well-fitting cap when the apparatus is in use, for the introduction of the fluid bisulphide of carbon; beside this, there is soldered to the inner vessel a gas-pipe of small bore, which pipe projects at a convenient height above the outer vessel; to this pipe is soldered and connected at right angles another pipe, provided with a stop-cock, and further connected, by means of elastic tubing, with a gas-holder containing oxygen gas made from chlorate of potash. After the application of gas-flame beneath the water-bath, the thermometer is watched, until it indicates that the vapour of the bisulphide of carbon is issuing from the burner (from the gas-pipe connected with the inner vessel); the heat is allowed to continue beneath the water-bath until the flame reaches the flaring point, when it is lessened almost to extinction. The oxygen gas is then cautiously introduced, upon which the flame at once diminishes in size and increases greatly in brilliancy. This light is proposed for use in photography on account of its great actinism; as a source of intense heat it may also, perhaps, be recommended.

NOTES ON LECTURE EXPERIMENTS.

New Carbonic Acid Generator.—This is but a modification of the spongy platinum hydrogen lamp, but the modification renders it very useful as a quick producer of gas on the lecture table. As in the hydrogen lamp, there are two receivers, one standing in the other: it is in the inside receiver that the charges are made. For the lump of zinc of the lamp is substituted a tray of perforated lead, with a rod, by which to hang in the receiver. A bit of lead is joined to the bottom of the tray (outside) to serve as a handle, when it is to be put into, or or removed from, the receiver. The tray has three feet, which leave space for the handle, and allow the liquid to drain off well. For use, the tray is filled with soda crystals, and hooked into the receiver; acid and water put into the outer receiver. The action is now just that of

the hydrogen lamp. One tray-full of soda is quite enough for a long series of experiments, but if more be required, in a minute the tray is taken out, emptied, and re-filled with crystals. Evidently this apparatus is just as useful for hydrogen production. The tray will hold a large quantity of granulated zinc, and with strong solution a steady flow will be kept up, with the cock full open. The other day, when putting by this apparatus, I observed for the first time, an interesting example of a heavy body floating. Crystals of soda, even very large, floated to the top of the acid solution, supported, I presume, by the evolution of gas. The soda could not be less dense than the solution. The crystals first fell to the bottom and then rose to the surface. It is, however, evident that the solution must have a certain strength; for I tried a second solution, and in this only small crystals floated: tested with a hydrometer, the second solution was less dense than the first.—E. KERNAN.

MEETINGS FOR THE WEEK.

MONDAY, May 3rd.—Royal Institution, 2. General Monthly Meeting.
—— Medical, 8.

TUESDAY, 4th.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."

WEDNESDAY, 5th.—Society of Arts, 8.

THURSDAY, 6th.—Royal Institution, 3. Professor Tyndall, "On Light."
—— London Institution, 6.
—— Chemical, 8. J. Lowthian Bell, Esq., F.C.S., "On the Chemistry of the Blast Furnace."

FRIDAY, 7th.—Royal Institution, 8. Capt. Moncrieff, "On the Moncrieff System of Working Artillery."
—— Geologist's Association, 8.

SATURDAY, 8th.—Royal Institution, 3. Prof. Seeley, "On Roman History."

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THE CHEMICAL NEWS.

VOL. XIX. No. 492.

SPECTROSCOPIC OBSERVATIONS OF THE SUN.

By J. NORMAN LOCKYER.*

No. IV.

I BEG to lay before the Royal Society very briefly the results of observations made on the 11th inst. in the neighbourhood of a fine spot, situated not very far from the sun's limb.

I. Under certain conditions the C and F lines may be observed *bright on the sun*, and in the spot spectrum also, as in prominences or in the chromosphere.

II. Under certain conditions, although they are not observed as bright lines, the corresponding Fraunhofer lines are blotted out.

III. The accompanying changes of refrangibility of the lines in question show that the absorbing material moves upwards and downwards as regards the radiating material, and that these motions may be determined with considerable accuracy.

IV. The bright lines observable in the ordinary spectrum are sometimes interrupted by the spot spectrum, *i. e.* they are only visible in those parts of the solar spectrum near, and away from, spots.

V. The C and F lines vary excessively in thickness over and near a spot, and on the 11th in the deeper portion of the spot they were much thicker than usual.

VI. Stars, in the spectrum of which the absorption lines of hydrogen are absent, may either have their chromospheric light radiated from beyond the limb just balanced by the light absorbed by the chromosphere on the disk, or they may come under the condition referred to in II., either absolutely or on the average.

ON THE COMPOSITION OF THE MILK OF THE SOW.

By Professor CHARLES A. CAMERON, Ph.D., M.D., Analyst to the City of Dublin.

WITH the exception of the milk of the sow, the lacteal secretions of the domesticated animals have been repeatedly analysed. Scheven appears to have been the only chemist who has published an analysis of sow's milk; but his results are so different from those of an analysis of sow's milk made by myself that I am induced to publish my analysis. In the sow's milk examined by me there was 6 per cent of fat, whilst in a specimen analysed by Scheven, the proportion of that constituent was under 2 per cent. It is not very easy to procure a specimen of sow's milk, and perhaps this is the reason why it has not hitherto been frequently analysed. I endeavoured on several occasions to obtain a small quantity, but the sows appealed to at my instigation were obdurate—they would not yield a drop, even when subjected to the dexterous manipulation of the most skilful dairymaids. At length, about two months ago, a specimen of sow's milk came into my possession; I am indebted for it to Thomas Baldwin, Esq., the Superintendent of Irish Agricultural Schools, and Director of the Glasnevin Government Model Farm. On submitting it to analysis, the following results were obtained:—Specific gravity, 1,041; colour, white, without any bluish shade; flavour very rich, resembling that of the skimmings of cow's milk; reaction, very faint alkaline. 100 parts contained:—

Water	81·80
Fats	6·00
Casein and other nitrogenous matters	5·30
Lactin	6·07
Mineral matter	0·83
	100·00
Total solids	18·20

The analysis was conducted as follows:—

a. A weighed portion of the milk was acidulated with a little acetic acid to prevent the formation of a skin, mixed with pulverised quartz (which had been previously boiled in hydrochloric acid, washed, and ignited) and evaporated in the water-bath to dryness.

b. The residue was treated with strong ether, by which the fats were dissolved. The ether was then evaporated and the residue of fats weighed. The fats were finally burned in a platinum capsule, and left no residue, proving the absence of mineral matter or casein.

c. The substance from which the fats had been removed was subjected to a nitrogen combustion, and from the amount of nitrogen obtained the proportion of casein and other nitrogenous substances present in the milk was estimated in the usual manner.

d. The proportion of lactin was found by difference, and also by the sulphate of copper method.

e. Determination of the mineral matter (ash). Five grammes of the milk were evaporated to dryness and the residue burned in oxygen gas. The amount of solid matter obtained by desiccating a weighed quantity of milk was slightly in excess of the sum of the weights of the individual constituents. It must, however, be borne in mind that the mineral matter in the nitrogenous substances is weighed twice—first, as a constituent of the casein, and, secondly, as an ingredient of the ash. Its amount, however, is trifling.

A comparison of the milk of the sow with that of the cow and other animals will show how extremely rich is the former.

Composition of the Milk of different Animals.

1,000 parts contain:—

	Water.	Butter.	Cheesy Matter.	Sugar.	Mineral Matter.
Woman	889·08	26·66	39·30	43·68	1·30
Cow	864·20	31·30	48·80	47·70	6·00
Goat	844·90	56·87	35·14	36·91	6·18
Ewe	832·32	51·31	69·78	39·43	7·16
Mare	904·30	24·36	33·35	32·76	5·23
Ass	890·12	18·53	35·65	50·46	5·24
Sow	818·00	60·00	53·00	60·70	8·30

Proportions of Solids and Water in different kinds of Milk.

	Woman.	Cow.	Goat.	Ewe.	Mare.	Ass.	Sow.
Water ..	889·08	864·20	844·90	832·32	904·30	890·12	818·00
Solids ..	110·92	135·80	155·10	167·68	95·70	109·88	182·00
	1000·00	1000·00	1000·00	1000·00	1000·00	1000·00	1000·00

The following particulars relative to the sow whose milk I have described were furnished to me by Mr. Baldwin:—"The sow whose milk I sent you is a pure Berkshire; she had pigged six days before the milk was withdrawn; she has a fair litter, and is an average nurse. She is receiving the sort of diet suited to her condition—viz., a mixture of small and damaged potatoes, pulped roots, and a little grains, the potatoes and roots being subjected to the action of steam. The food is not too rich, but just sufficient to keep herself and her young in a good healthy condition."

Pig's milk is extremely rich, containing, as it does, nearly 50 per cent more nutritive matter than is found in that of the cow. It is not unlikely that in certain forms of disease where a milk diet is prescribed the use of so concentrated a liquid food might prove serviceable.

102, Lower Baggot Street, Dublin.

* Read before the Royal Society, April 28th, 1869.

ON SOME APPLICATIONS OF ELECTRICITY TO NAVAL AND MILITARY PURPOSES.*

By F. A. ABEL, F.R.S., For. Sec. C.S.

THE applications which electric science has received within the last few years in connection with the military and naval services are various and important. The employment of the electric light for signalling and reconnoitring purposes; the permanent establishment of telegraphic equipments by which an army in the field or at a siege is maintained in the most intimate communication with the directing powers; the employment of electric signalling arrangements in ships of war, and the accurate investigation of the ballistic force of gunpowder and other explosive agents, are among the uses to which electricity has been put in connection with war purposes; but the earliest application, and one of the most important and extensive—one, moreover, possessing great interest from industrial points of view—is the employment of electricity as an agent for exploding land- and submarine mines.

The possibility of applying the electric spark to the ignition of charges of gunpowder suggested itself both to Franklin, in 1751, and to Priestley in 1767; but it was not until some years after the discovery of the electric pile by Volta, that serious attempts were made to apply electricity to mining and military purposes. The first practical application of the voltaic battery in this direction was made little more than thirty years ago by French military Engineers; a few years afterwards that agent was successfully applied in this country in connection with important blasting operations, such as the destruction of Round Down Cliff at Dover, and the removal of the wrecks of the *Royal George* and *Edgar* at Spithead. The general method of operation then pursued was adhered to by military Engineers in this country until very recently, and is, in fact, still occasionally employed, though it has been in great measure superseded by other systems which present very important advantages. It consists in inserting into the charge of gunpowder a short piece of thin wire, composed of a metal of inferior conducting power, such as iron or platinum, and placing this wire into connection with the circuit wires of the battery. The resistance offered to the passage of the current gives rise to the development of heat, the intensity of which is regulated by the conducting power and the length and thickness of the wire. The latter may, in this way, be raised to a red heat, or even fused; and thus, by completing circuit through the wire at the desired moment, a charge of powder may be inflamed. A number of charges may be simultaneously exploded by introducing several pieces of thin wire into the circuit.

Although the employment of a voltaic current of low tension presents obvious and great advantages over old systems of igniting charges by trains or slow-burning fuses, its application to military purposes is attended with some difficulty and uncertainty, arising out of the want of uniformity of action of the same voltaic arrangements at different periods, the difficulties attending the transport and proper preservation of the battery and materials required for its use, the dependence for success upon care and experience in preparing and preserving the batteries, and the very considerable increase which it is necessary to make in the power of the battery when the operations to be performed involve the simultaneous explosion of a number of charges, or the ignition of gunpowder at very considerable distances from the battery.

For these reasons, soon after the first successful application of voltaic electricity to mining purposes, the attention of military Engineers on the Continent, and of others here and abroad who were specially interested in operations of this kind, became directed to the possibility of rendering electricity of high tension available for exploding purposes, whereby voltaic batteries, for mining operations, might be greatly reduced in size, if not altogether dispensed with.

In 1853, a Spanish officer, Colonel Verdu, associated himself with M. Ruhmkorff in experiments on the application of electro-magnetic induction coils to the explosion of gunpowder. The success of their experiments led Colonel Verdu to pursue them further in Spain, where he soon succeeded in firing six mines simultaneously by one element of Bunsen's battery, at a distance of upwards of three hundred yards, through the agency of the Ruhmkorff coil. The mode of operating and difficulties which Colonel Verdu had to overcome will be presently described. While the success of these operations led the military Engineers in Spain, France, and Russia to pursue the development of the application of electro-magnetic induction instruments to exploding purposes, a committee of Austrian military Engineers (of which Baron von Ebner was from the first a most distinguished member) was labouring to apply frictional electricity to military uses as an exploding agent, having come to the conclusion that the electro-magnetic induction apparatus was too complicated and too greatly susceptible of derangement for military uses. But little success had up to that time attended attempts to apply frictional electricity to this purpose. In 1831, Moses Shaw, of New York, succeeded in exploding several mines simultaneously by means of frictional electricity, but was foiled in his attempts to apply this agent to practical purposes, by the fact that he could not conduct operations with any chance of success except in very dry weather. Somewhat more promising results attended several attempts in Germany between 1842 and 1845; but the prospect of practical success was still not encouraging when the Austrian Committee of Engineer Officers took the matter in hand, and eventually produced a portable glass frictional electric machine, which, when in good working order, furnished results surpassing those which had been obtained with volta-induction apparatus. Some very extensive operations were conducted with this machine; thus, fifty land charges and, afterwards, thirty-six submarine charges, were simultaneously exploded. Even, however, with all the precautions adopted, the machine was still too seriously affected by damp to be thoroughly serviceable for military purposes. But the persevering labours of Baron von Ebner eventually resulted in the production of an electric machine which was almost entirely free from the objections hitherto attached to this form of apparatus.

While the progress just indicated was being made in different parts of the Continent in the application of electricity to mining operations, but little attention was directed in this country to effecting improvements in the utilisation of electricity for military mining purposes. In 1855, however, Sir C. Wheatstone directed the attention of Field-Marshal Sir John F. Burgoyne to the importance of instituting an experimental inquiry into the relative advantages of different sources of electricity of tension as agents for exploding gunpowder. The Ordnance Select Committee, of whom Sir C. Wheatstone and Mr. Abel were then members, were consequently instructed to pursue this inquiry; and a series of investigations was carried out, in the first instance, to a working branch of the Committee, and subsequently by Mr. Abel at Woolwich and Chatham, the results of which were eventually embodied in a report presented by the above-mentioned gentlemen to the Secretary of State for War in 1860. Since then Mr. Abel, as a member of the Government Committee on Floating Obstructions, has continued systematic investigations on the applications of electricity to the explosion of mines, and especially to submarine operations, and considerable improvements and simplifications of the arrangements and appliances have resulted. Some advance has also been made on the Continent in this subject, and during the last two or three years our military Engineers have acknowledged in the most practical manner the advantages to be derived from the use of

* A lecture delivered before the Royal Institution of Great Britain, March 12, 1869.

electricity of tension as the agent for exploding mines, by gradually and to a very great extent abandoning the old system of operation, and by devoting considerable attention to the practical elaboration of the new systems.

The following is an outline of the results obtained up to the present day with different classes of instruments which furnish electricity of tension.

It has been stated that Colonel Verdu succeeded, in 1853, in exploding several mines simultaneously by means of a Ruhmkorff induction coil. The ignition of the gunpowder was effected in these experiments by introducing one or more small but complete interruptions into the circuit, across which the electric spark of high tension would leap upon the current being passed. This spark will inflame gunpowder, but not very readily, although its production is attended with development of heat considerably in excess of that required; the reason being that powder requires for ignition either the close proximity of a considerable heated surface, or the continuous application to heat for a brief period, while the disruptive discharge from an induction coil consists of a series of instantaneous discharges following each other in very rapid succession. Hence a charge of gunpowder is not always instantaneously fired when the spark is passed; indeed, unless the powder be closely confined round the wire terminals between which the spark passes, it is sometimes dispersed by the mechanical action of the spark without being exploded; and when a succession of sparks is passed simultaneously through a number of charges, it frequently happens that only a few are exploded, in which some of the grains happened to be in positions or conditions more favourable with reference to the source of heat than in other instances, where the powder would escape ignition. Colonel Verdu succeeded in increasing the certainty of simultaneous ignition of several charges, by surrounding the wire terminals with a substance much more readily inflamed than powder—the fulminate of mercury. Another source of difficulty in effecting the simultaneous ignition of a considerable number of charges by the spark from the coil is the enfeebling effect upon the spark-discharge exerted by a number of successive small interruptions in the circuit. This was to some extent overcome by employing a fuse constructed by Messrs. Statham and Brunton, in which the space between the wire terminals was bridged over with a film of a finely-divided substance—the subsulphide of copper—the conducting power of which is sufficiently great to aid the passage of the electric discharge across the interruption, while it is at the same time readily combustible, and therefore directly promotes the ignition of the powder. Finding that, even with the combined use of this fuse and of fulminate of mercury, the power of the induction coil to explode charges simultaneously was limited, Colonel Verdu adopted the following simple arrangement:—Separate small groups of mines were all connected with earth, and an insulated conducting wire connected each group with a distinct small insulated plate. By bringing thes plates in very rapid succession into circuit with the coil machine, the several groups were so rapidly exploded as to produce results somewhat similar to those attainable by the really simultaneous discharge of a considerable number. Not long after this contrivance was adopted by M. Verdu, M. Savare devised another arrangement, whereby a much more rapidly successive discharge of a number of mines was accomplished through the agency of the coil. The metallic circuit which passed to the mines was divided into a number of branches, so that, upon completion of the circuit, the currents, following each other in very rapid succession, would distribute themselves through all the branches with a degree of uniformity regulated by the resistance met with in each branch. Thus, when one or more fuses were interposed in each branch of the circuit, those which happened to offer the greatest facilities for the passage of the current would be first fired, whereupon the escape of electricity in that direction would be interrupted, and the explosion of fuses in the other branches would follow. With the employment of currents following each other with the enormous rapidity with which they pass off from the induction coil machines, the discharge of a number of mines may thus be effected with a rapidity which, practically, has almost the effect of a simultaneous discharge.

The Ruhmkorff coil was used to some extent by the Russians in mining operations during the Crimean war, and some very extensive blasting operations were carried on with its aid at Cherbourg in 1854. A series of experiments was instituted at Woolwich in 1856 with two excellent induction coils, produced by M. Ruhmkorff, in the course of which various descriptions of materials were tried in the fuses, for the purpose of increasing the power of the machine to fire numbers of charges simultaneously. At that time the fulminate of mercury was found to be the best inflaming agent; but not more than twelve charges were fired simultaneously by means of the most powerful coil available and a battery of twelve cells (without employing Verdu's or Savare's methods of explosion). One defect in this class of instrument was found to be the want of uniform action of one and the same apparatus at different periods; another was the liability to derangement of the machine, especially of the condenser. Far more successful results were afterwards obtained with the same coils and the fuse constructed at a later period of these investigations; fifteen charges were fired simultaneously with a battery of six cells and fifty charges, arranged in branch-circuit in groups of ten, were exploded with the effect of a simultaneous discharge. These results were obtained with machines produced by Ruhmkorff in 1855; but the improvements since then effected in the construction of this apparatus have reduced to insignificance the results at that time obtained with it. There is no question therefore that the Ruhmkorff coil is available for special operations of considerable magnitude; but in point of simplicity, certainty, and constancy of action, it is far surpassed by other forms of electric instruments, which will be presently noticed.

At the suggestion of Sir Charles Wheatstone, experiments were commenced in 1856 on the application of currents *induced by permanent magnets* to the explosion of gunpowder. The first experiments were instituted with a very large and powerful magneto-electric machine, constructed by Mr. Henley, of which the armature, carrying two powerful coils, was suddenly detached from the magnet by means of a lever. A few experiments sufficed to show that the induced current obtained even with this powerful instrument was not adequate to ignite one single charge of gunpowder with certainty. Somewhat better, but still uncertain, results were obtained with Statham's and one or two others forms of fuses existing at that time. A careful investigation was then undertaken by Mr. Abel (with the invaluable assistance of Mr. Brown, of the Chemical Department, Woolwich), into the conditions to be fulfilled in the production of a fuse which should be certain of action with the magneto-electric machine. The results of extensive experiments indicated that a combination of comparatively high conducting power with great susceptibility to ignition appeared to be essential elements of success in a material to be used as the exploding agent in a fuse. The uniform arrangement of the poles or wire terminals in the fuse, the space between which was to be bridged over by the igniting composition, also proved a matter of great importance. A mode of constructing the fuses which ensured perfect uniformity in this respect was ultimately perfected, and has proved quite successful. A very fairly efficient fuse was obtained with the aid of the poles thus arranged, by employing as the igniting agent gunpowder impregnated with a small proportion of calcic chloride, which caused it, upon brief exposure to air, to imbibe moisture sufficient to render the gunpowder highly conducting. It is obvious, however, that, although the fuse itself was hermetically closed when complete, there must be a liability to want of uniformity in the proportion of water absorbed by the powder, and a consequent variation in the conducting power of the latter. Eventually a

material was prepared (consisting of the subphosphide of copper, subsulphide of copper, and potassic chlorate) which combined the essentials of perfect certainty of action with very great sensitiveness to ignition. Henley's large magnet fired *three* of these fuses simultaneously with perfect certainty, while a small horse-shoe magnet with revolving armature exploded 25 in divided circuit in exceedingly rapid succession. A combination of six small compound magnets was afterwards employed, with which an exceedingly rapid succession of currents was obtained, and this apparatus exploded twenty-five fuses in divided circuit with a rapidity which to the ear had the effect of an instantaneous explosion. Even the small magneto-electric instruments which are used for medical purposes will explode these fuses with certainty.

The application of magneto-electric machines having been successfully accomplished, a series of experiments was carried on by Mr. Abel, with the valuable aid of Colonel H. Scott, R. E., at Chatham, during the years 1857-58, on the explosion of charges, both land and submarine; and the great advantages of these instruments, as regards simplicity and permanent efficiency, over the voltaic arrangements hitherto used, was fully demonstrated. Very compact but powerful exploding instruments were constructed by Sir C. Wheatstone, and these have for the last seven or eight years received many important applications; thus, the proof of cannon at Woolwich and the firing of guns, from a safe distance, in the numerous experiments at Shoeburyness, is effected by means of Wheatstone's exploder, which is, moreover, an important adjunct in all electro-ballistic experiments, when the operator desires himself to fire a gun at a particular moment. Magneto-electric machines have also been found very useful in connection with blasting operations on land, except in instances when the absolutely simultaneous explosion of a large number of mines is required.

Since the success of Wheatstone's exploders has been fully established, several other forms of magneto-electric machines have been devised, especially on the Continent and in America. Powerful instruments similar to Wheatstone's are manufactured by Siemens and Halske, of Berlin; Markus, of Vienna, has constructed very efficient instruments in which one separation and return of the armature to the magnet are made to explode the charges. The disadvantages of these instruments is that a *succession* of currents cannot be obtained from them as in the case of machines with revolving armatures; hence the number of mines which can be exploded by them in divided circuit is comparatively limited. Mr. Beardslee, an American, has also devised a modification of Wheatstone's exploder, in which the magnets are made to revolve between the armature coils, and which furnishes currents of greater quantity but lower tension than Wheatstone's. The fuse constructed by Mr. Beardslee, for employment with this instrument is similar in principle of construction to Abel's; but the materials which bridge over the space between the terminals or poles of the fuse are black-lead, with the addition of a minute quantity of some substance, apparently collodion, which adds to the size of the scintillations produced when the currrent passes, and thus increases the certainty of ignition of the powder which is in close contact with the poles. These fuses are efficient with magneto-electric instruments like that of Mr. Beardslee, but they are much less delicate than the Woolwich fuses, and the number which can be simultaneously exploded is therefore much more limited. Sir C. Wheatstone has also lately constructed more powerful modifications of his original magnetic exploder, which may, at will, be made to furnish currents of greater quantity and lower tension, or to produce the high tension currents. Lastly, Mr. Ladd and Mr. Browning have produced instruments of comparatively low price, but quite powerful enough for ordinary blasting and quarrying operations. The only obstacle, but a most important one, to the general use of these machines, for the explosion of mines on land and under water is, that very slight defects in the insulation of the conducting wire which leads from the instrument to the mines are quite fatal to its exploding power. In consequence of the high tension of the current developed by these machines, and the small quantity put into circulation by even the most powerful of them, the diversion of the current from its destined course to earth is promoted by the smallest points of escape presented to it; a result which is, moreover, facilitated by the resistance of the fuses in circuit. With care this source of failure can be guarded against in operations on land, but such is not the case with regard to submarine arrangements; while, moreover, minute defects in the coatings of the *submerged* wires, which would hardly influence the results at all on land, completely nullify the exploding power of the machines. Hence magneto-electric instruments are the least reliable of all electric exploding apparatus for submarine purposes.

A few experiments were instituted at Woolwich in 1857 on the employment of *frictional electricity* as an exploding agent, and especially with a small hydro-electric machine constructed for the purpose by Sir William Armstrong. As regards its power of exploding a number of charges simultaneously, when it was in good working order, it far exeeeded any other instrument experimented with at that time: one hundred fuses, arranged in a single current, were frequently exploded by its means; but the great uncertainty of its action, and the difficulty of employing it in the field did not afford encouragement for a continuation of experiments with it.

The great difficulties encountered in the Austrian experiments in the attempts to employ glass frictional electric machines as exploding agents for military purposes, led Baron von Ebner to direct his attention to the production of an instrument in the construction of which glass was altogether avoided, and which might therefore be expected to be less subject to atmospheric influences. His labours in this direction were eventually crowned with success; for he found in the hard vulcanised india-rubber (known as ebonite or vulcanite) a dielectric material excellently adapted to the construction of the frictional apparatus; while by employing a sheet of vulcanised india-rubber coated with tinfoil and compactly rolled up he obtained without the use of glass a powerful condenser, or Leyden jar arrangement. The improved machines were constructed in a very compact form (with cases excluding all the working parts from direct exposure to air) by Messrs. Siemens, of Berlin, and Lenoir, of Vienna, who exhibited specimens in England in 1862, at which time the electric machine had already received important applications in the Austrian service, and had been regularly adopted for military uses. Baron von Ebner had also, from the commencement of the Austrian experiments, laboured assiduously at the production of an efficient fuse to be used with electricity of tension; and the Austrian service is indebted to him for a simple and thoroughly serviceable fuse, which, as regards the arrangement of its poles and the character of the igniting composition, may be said to combine the principles of the Statham and Abel fuses. Though less sensitive than the present English service electric fuse, a very considerable number may be exploded in simple circuit by the ebonite electric machine. The power of this apparatus in its portable form is nearly equal to that of the hydro-electric apparatus just now referred to, when the latter is in perfect working order. A far greater number of mines may therefore be simultaneously exploded by its means than by very large batteries or by the most powerful magneto-electric machines hitherto constructed. One hundred of Abel's fuses have frequently been simultaneously exploded with one of the portable machines, and still greater results can be obtained with a larger instrument having a battery of condensers, which was specially constructed for submarine operations by Mr. Becker, at the suggestion of Captain Maury. In very damp weather, when the most perfect glass electric machines would have been useless unless housed in a warm apartment from which the external air was as

much as possible excluded, these ebonite machines have been used from time to time throughout the day with very satisfactory results.

Another important advantage which these instruments possess over magneto-electric machines consists in the fact that very considerable defects in the insulation of even submerged conducting wires do not so greatly reduce the power of the current furnished by them as to interfere with the accomplishment by its agency of the most extensive operations under water which are likely to occur in practice. Unfortunately, however, the very circumstance which constitutes its chief advantage, namely, the powerful character of the current of high tension with which it charges an insulated wire, is also a source of serious defect, to be presently noticed, which very greatly limits the applicability of these machines to naval and military purposes.

(To be continued).

ON THE ESTIMATION OF COPPER IN ORES,

BY CERTAIN METHODS FOR WHICH A PREMIUM HAS BEEN AWARDED.*.

(Concluded from p. 209.)

Estimation of Copper in the Mansfeld Ores, according to the Method proposed by M. C. Luckow, at Deutz.

For a few years, the gentleman just named has applied to the quantitative estimation of copper present in salts, alloys, and ores, a new method, based upon the precipitation of the metal in metallic state, from solutions containing either free sulphuric or nitric acids, by means of a galvanic current.

It is a great advantage of this method, that, while the copper is precipitated, it is simultaneously separated from metals with which it is often found alloyed, some of which, such as tin and antimony, are separated by treatment with nitric acid in an insoluble form, while others, like silver, can easily be removed in the form of chloride. It is, at the same time, another advantage that the state in which the copper is obtained, admits of its being accurately weighed and estimated, while a great number of operations, which require much time and various apparatus, is, at the same time, got rid of.

Although, already some four years ago, M. Luckow had discovered a method of electro-metallic analysis from fluids containing free sulphuric acid, his researches on the same subject, in the case of free nitric acid, belong to a later period. These researches brought very unexpectedly to light the curious fact, that even a weak galvanic current had the power to completely precipitate copper in a pure metallic state, from solutions which did not contain more than 0·1 grm. of anhydrous nitric acid to the c.c. (nitric acid of 1·2 sp. gr. contains 0·32 grm. of anhydrous nitric acid to the c.c.), while it was, at the same time, found that the action was more regular, and less dependent upon the power of the current than when free sulphuric acid was present. The following more commonly occurring metals are *not* precipitated by galvanic action from acid solutions:—Zinc, iron, nickel, cobalt, chromium, the metals of the earths, and alkalies. There are precipitated—

(*a*). In the shape of peroxides, at the positive electrode: completely, lead and manganese; incompletely, silver. When the solution contains traces of manganese, it becomes, in consequence of the formation of a salt of peroxide of manganese, or permanganic acid, deeply violet coloured. This very sensitive reaction for manganese also takes place when small quantities of chlorine are present. The presence in the fluid of oxalic, lactic, and tartaric acids, and other readily oxidisable organic substances, and such protoxides as are readily peroxidised—for instance, protoxide of iron—retard the formation of peroxides, as well as the setting-in of the reaction of manganese.

(*b*). Precipitated at the negative electrode in metallic state, are mercury, silver, copper, and bismuth. When mercury is present in the solution simultaneously with copper, the former metal is separated before the latter, in the fluid metallic state. As soon, however, as the precipitation of copper commences, there is, when mercury is also present, formed an amalgam of the two metals. Silver is precipitated almost simultaneously with copper; bismuth only begins to be precipitated after the greater portion of the copper has been already separated. A complete separation of silver only ensues when some such substance as tartaric, or any other similar acid is simultaneously present in the solution. The separation of the three last-named metals, by means of galvanic action, is, therefore, unsuccessful; but, fortunately, we have plenty of other means to accomplish this end completely.

(*c*). Metallic arsenic is only precipitated slowly; and long after the complete separation of copper, is the former metal separated from arsenic acid, if it should happen to be present. The same remark applies to antimony, since it is well known that small quantities of antimonic acid are soluble in nitric acid.

The operations, according to Luckow's plan, are—I. Roasting of the ore; II. Solution of the roasted product; III. Precipitation of the copper; IV. Weighing of the copper.

I. *Roasting of the Ore.*

Care should be taken to obtain a finely-ground, average sample of the ore. M. Luckow then weighs off, in previously accurately counterpoised small porcelain capsules, quantities of from 1 to 3 grms; these quantities are then placed on the inverted lid of an iron crucible, on the inner surface of which the powdered ore is heated, over the flame of a Bunsen gas-burner. The powder may be carefully stirred up with a platinum wire, to promote the access of air during the roasting, and the ignition of bituminous matter and sulphur may be ended in about seven minutes. Ores which do not contain bitumen at all need not be roasted.

It has been already stated that, especially as regards poor copper ores (and those of the Mansfeld district are generally so), the quantities to be weighed off for assay should not vary according to a presumed percentage of copper. One gramme is too small a quantity; 2 grms. are now taken, and, instead of roasting the ore on the lid of an iron crucible, small porcelain crucibles are applied for that purpose.

II. *Solution of the Roasted Product.*

According to M. Luckow's plan, the iron lid is suffered to cool, the roasted powder placed on a piece of glazed paper, and any powder adhering to the lid is removed by means of a camels-hair brush, on to the paper. The powder is next transferred to small beaker glasses, and some 2 or 3 c.c. of nitric acid, of 1·2 specific gravity, are added, along with about 10 to 15 drops of concentrated sulphuric acid. The beakers are then placed on a sand-bath, and moderately heated, at first; but when the contents have nearly become dry, the heat is increased, so as to evaporate and expel all sulphuric acid. The beakers should be covered with perforated watch glasses. This operation requires from about three-quarters to one hour. The addition of sulphuric acid is made in order to increase the oxidising action of the nitric acid, and also to convert any lime which may happen to be present in the ore into a difficultly soluble salt. It is very useful, also, to add some 10 or 20 drops of hydrochloric acid to the mixture of the two acids just alluded to, since the rapidity of the evaporation is thereby increased, and the occasional spirting about of the fluid is lessened.

The process just described is modified, of course, first by the use of porcelain capsules, the contents of which

are easily transferred to beakers with flat bottoms, and not higher than about 2 inches in all. It is better, also, to use a sulphuric acid, prepared of equal bulks of concentrated acid and water, and to measure off 4 c.c. for each assay; while for each assay, moreover, 6 c.c. of nitric acid, and about 25 drops of hydrochloric acid are taken. Instead of covering the beaker with a perforated watch glass, a funnel is used, as represented in Fig. 1; with this arrangement, the sulphuric acid evaporates far more readily, and loss by spirting is prevented. The beaker is heated on a well-arranged sand-bath.

III. *Precipitation of the Copper.*

As soon as the beaker-glass, after removal from the sand-bath, has become quite cool, the funnel which has been used as a cover is washed on both sides, inner and outer, with nitric acid of 1·2 sp. gr., diluted with six times its bulk of pure water; the sides of the beaker are next likewise washed, and the latter filled to about half its height

Fig. 2.

Fig. 1.

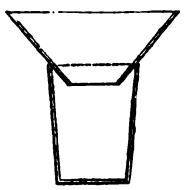
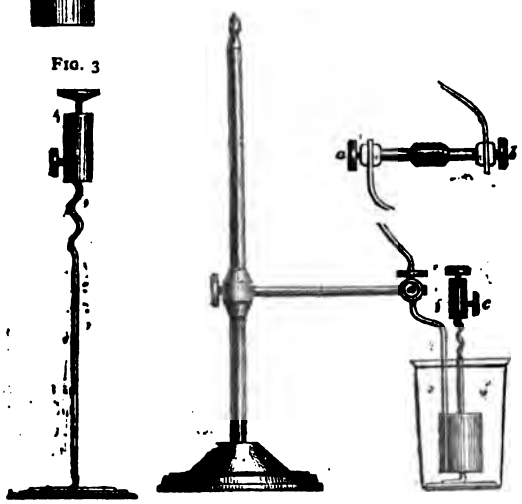


Fig. 4.

Fig. 3



with the same acid. A few drops of a concentrated solution of tartaric acid are added (which acid, by the bye, is best kept in solution in open vessels, only slightly covered with a piece of paper); this having been done, the wire spiral, represented in Fig. 2, is carefully placed into the beaker-glass. This spiral consists of a piece of platinum wire, about 1-12th of an inch thick, and 7½ inches long, while two-thirds of its length is so wound that the straight end of the wire projects as if it were the axis of the centre of the spiral. The convolutions of the spiral are so large that they touch the sides of the beaker, while the straight portion just touches the centre of the bottom of the vessel.

When the heating has been carefully attended to, the acid fluid added to the contents of the beaker, after evaporation to dryness, will generally be quite clear; if it happens to be turbid, 1 or 2 c.c. of a concentrated solution of nitrate of baryta may be added, and the thorough mixing of this saline solution with the acid contents of the beaker promoted, by gently moving up and down the platinum spiral just alluded to, and allowing the fluid to rest for a few minutes after. The copper present in the mass left at the bottom of the beaker gradually dissolves; and it is not actually requisite to wait for applying the galvanic current until it is all dissolved.

The next point is to place in the beaker the platinum foil, represented at Fig. 3, of which the dimensions are:—length, 2½ inches; width, 1¼ inches. The lower end of this platinum foil should be left about 1-16th of an inch apart from the convolutions of the spiral. When the beaker is only half filled with liquid, the platinum foil is immersed in the same for more than three-fourths of its height. The wire fastened to the said foil is fixed, by means of a screw *a*, to the arm *ab* of the stand, represented at Fig. 4; the other screw, *b*, serves to fasten a copper wire, proceeding from the zinc plate of the galvanic battery. When the small screw clamp *c* (Fig. 4) has been fastened to the platinum wire placed in the beaker, another wire is fastened in the top opening of the clamp just referred to, and this wire connected with the copper plate of the battery, and the galvanic circuit thus closed. In a few moments after this has been done, the platinum foil, bent in the shape of the cylinder and placed inside the beaker, as before described, will be observed to become covered with a coating of metallic copper, while from the platinum wire spiral bubbles of gas escape, which facilitate, to some extent, the solution of the oxide of copper in the dilute acid.

In order to ascertain whether the whole quantity of the copper has been precipitated, some more dilute nitric acid is added to the fluid in the beaker-glass. If, in ten minutes after this, no more metallic copper is separated on the clean portions of the platinum foil, the operation is finished.

It is to be here observed that continued practice has proved that the addition of a concentrated solution of nitrate of baryta acts injuriously on the process, in so far as the metallic copper, which becomes separated, gets mixed with some insoluble sulphate of baryta, which increases the weight of the substance to be weighed. The cylinder made of platinum foil, should not be at a greater distance from the platinum spiral wire than about 1-16th of an inch.

The time occupied by the complete precipitation of the metal varies according to the force of the galvanic current. It varies in duration from three to even eight hours. In order to make this point certain, all test assays are left for eight hours consecutively, in contact with the galvanic current, experience having proved that, after that lapse of time, even with a weak current, the precipitation was so complete that all chemical reagents, even the most delicate, for detecting copper, failed to discover even the most minute trace of that metal.

IV. *Weighing the Copper.*

According to M. Luckow's plan, the platinum cylinder to which the copper adheres, and the platinum wire spiral are disconnected from the galvanic apparatus, the platinum cylinder carefully removed from the beaker and immediately plunged into a beaker filled with fresh cold water, and rinsed therein; next washed with alcohol, by means of a washing bottle, and then dried in a drying apparatus, and weighed after cooling. Since the platinum cylinder had been very accurately weighed *before* the experiment, its increase in weight will, of course, be that of the copper obtained.

The process here described has been somewhat modified and greatly improved upon at Eisleben, where it is in constant use, by means of a series of galvanic elements. It is, in the first place, found better not to disconnect the galvanic current while yet the copper is in contact with acid, so that, instead thereof, the acid fluid in the beaker is replaced by running in a stream of water, and suffering the same to run over the sides of the beaker, and to be

received into a proper vessel to hold it. In this manner all the acid is displaced, without risk of any very small quantity of copper becoming acted upon by the acid during the brief period lapsing between the disconnecting of the galvanic current and the removal from the beaker of the platinum cylinder and spiral wire. These parts, on being removed, are carefully washed, first with boiling water, next with alcohol, and then dried, at a temperature of about the boiling point of water. The cylinder is then weighed, and, after that, the copper coating is removed therefrom, by means of nitric acid; next washed in water, dried, and again weighed.

There are in use at Eisleben nine galvanic batteries (lead and zinc elements); these yield eighteen assays ready for weighing in twenty-four hours. It would be easy for the person there employed to work with twelve batteries each of three elements. The results obtained are highly satisfactory. The following observations may be made in reference to this method:—

(*a*). The quantity of ore taken for trial is 2 grammes, and is found sufficient, while it consumes less acid.

(*b*). The evaporation of the acid is carried on to complete dryness on the sand-bath. Spirting of the fluid is easily prevented; when the copper has been precipitated properly it will show its peculiar colour on the surface, and the good success of the operation may be judged from the fact, also, that no saline matter adheres to the platinum; the complete absence of which saline matter has been found to be evidence of complete removal of the copper from the fluid.

The process just described is especially applicable and useful for rather poor ores, such as do not contain above 7 or 8 per cent of copper. Each assay, from begining to end, takes ten hours for complete analysis; but it is evident that the longer portion of this period is such as does not give active employment to the assayer. The expense of working this process, after the apparatus have been once purchased, is very small indeed. The process may be applied to analyse rather rich ores, and also of alloys of copper, with some slight modifications, which require attention, especially, also, if silver should happen to be present.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Annual Meeting, Saturday, May 1st, 1869.

Sir HENRY HOLLAND, Bart., M.D., D.C.L., F.R.S., President, in the Chair.

THE Annual Report of the Committee of Visitors for the year 1868 was read and adopted.

The books and pamphlets presented in 1868 amounted to 116 volumes, making, with those purchased by the managers, a total of 220 volumes added to the library in the year, exclusive of periodicals.

Fifty new Members were elected in 1867.

Sixty lectures and twenty evening discourses were delivered during the year 1868.

Thanks were voted to the President, Treasurer, and Secretary, to the Committees of Managers and Visitors, and to the Professors, for their services to the Institution during the past year.

The following gentlemen were unanimously elected as officers for the ensuing year:—

President—Sir Henry Holland, Bart., M.D., D.C.L., F.R.S.

Treasurer—William Spottiswoode, Esq., M.A., F.R.S.

Secretary—Henry Bence Jones, M.A., M.D., F.R.S.

Managers—George Berkley, Esq., C.E.; William Bowman, Esq., F.R.C.S., F.R.S.; Charles Brooke, Esq., M.A., F.R.S.; George Busk, Esq., F.R.C.S., F.R.S.; Adm. Sir Henry John Codrington, K.C.B.; Warren De la Rue, Esq., Ph.D., F.R.S.; John Peter Gassiot, Esq., F.R.S.; John Hall Gladstone, Esq., Ph.D., F.R.S.; Wm. Robert Grove, Esq., M.A., Q.C., F.R.S.; George Macilwain, Esq.; The Duke of Northumberland; William Frederick Pollock, Esq., M.A.; Robert P. Roupell, Esq., M.A., Q.C.; The Hon. John William Strutt; Colonel Philip James Yorke, F.R.S.

Visitors—Andrew Whyte Barclay, M.D.; Charles Beevor, Esq., F.R.C.S.; John Charles Burgoyne, Esq.; Sir C. Wentworth Dilke, Bart.; Alfred Gutteres Henriques, Esq.; Sir Thomas Henry; Thomas Hyde Hills, Esq.; Thomas Lee, Esq.; William Longman, Esq.; Edward Henry Moscrop, Esq.; Rev. Cyril W. Page, M.A.; Edmund Pepys, Esq.; The Lord Josceline W. Percy; Arthur Giles Puller, Esq., M.A., F.S.A.; Robert Ballard Woodd, Esq., F.S.A., F.R.B.S.

General Monthly Meeting, Monday, May 3rd, 1869,

Sir HENRY HOLLAND, Bart., M.D., D.C.L., F.R.S., President, in the Chair.

THE following Vice-Presidents were nominated for the ensuing year:—The Duke of Northumberland; William Spottiswoode, Esq., F.R.S., the Treasurer; J. P. Gassiot, Esq.; and George Busk, Esq.

Lieut.-Colonel Archibald Campbell Campbell; Sir William Dickason Clay, Bart.; William Wilbraham Ford, Esq.; John Benjamin Marsden, Esq.; and Herbert Schloss, Esq., were elected Members of the Royal Institution.

John Tyndall, Esq., LL.D., F.R.S., was re-elected as Professor of Natural Philosophy.

The Managers announced that, in conformity with the deed of endowment, they had appointed Michael Foster, M.D., F.L.S., Fullerian Professor of Physiology.

FRENCH ACADEMY OF SCIENCES.

Monday, April 26th, 1869.

A communication was read from the REV. FATHER SECCHI, S.J., "*On the Spectroscopic Phenomena of the Sun's Spots*" recently observed by him; he finds that the spectra of these spots present great analogy with those of the stars known as Arcturus and Aldébaran. He also mentions that the different spots he had the opportunity to examine on the sun's disc exhibit differences identical to those which characterise the spectroscopical appearances of the stars.

During the proceedings of this meeting, at which no papers or communications on chemistry were sent in, several papers were read, and a long discussion ensued, on the aurora-borealis alluded to in our last report of the meetings of this scientific body; it appears that the phenomenon has been observed even in the southern parts of France, while perturbations of magnetic instruments have been reported from Leghorn as well as from Greenwich.

A discussion, wherein M. Sainte-Claire Déville took a prominent part, on the changes produced in the weather, barometric pressure, and temperature subsequent to the observation of the aurora-borealis, led to no definite result as far as the fixing of causes and effects in this matter is concerned.

M. L. HUGO, from Versailles, addressed a note "*On the Construction of a Synoptic Pyrheliosope*," by means of which instrument it would be possible to see all the solar protuberances at the same time; the instrument is intended to be a spectroscope to which, by means of suitable clock-

work, an angular motion may be imparted. The note and description were handed over to a committee to report thereon.

Two papers relating to electricity were read, but as both belong rather to the domain of higher mathematical physics, they are unfit and too abstruse for abstraction in our pages.

NOTICES OF BOOKS.

A History of Chemical Theory from the Age of Lavoisier to the Present Time. By Ad. Wurtz, Membre de l'Institut (Académie des Sciences). Translated and Edited by Henry Watts, B.A., F.R.S. London: Macmillan and Co., 1869. Pp. 220, 8vo.

Our readers will recognise under the above title the "Discours préliminaire" which constitutes a kind of preface to M. Wurtz's "Dictionnaire de Chimie" now publishing in France. A work in the English language, and specially devoted to chemical history, appears so seldom in this country, that we purpose commenting upon it at somewhat greater length than the intrinsic merits of the book might appear to demand.

M. Wurtz's *history* commences with a brief introduction, which is followed by four chapters in which attention is directed to the respective doctrines of Lavoisier, Dalton and Gay-Lussac, Berzelius, and Laurent and Gerhardt. Another chapter is devoted to the discussion of existing theories; and this is followed by a few explanatory notes, to which the editor has judiciously added.

The opening sentences of the introduction are not likely to meet with very general acceptance among chemists who are acquainted, even but a little, with the development of existing doctrines. That "chemistry is a French science," and that "it was founded by Lavoisier," are two propositions which reduce the whole subject, not only to a nationality, but to an individual, and neither of these propositions has any historical foundation whatever. We also feel bound to deny—in language no less decided than that of M. Wurtz, who affirms that; for ages preceding Lavoisier, chemistry "had been nothing but a collection of obscure and often fallacious receipts"—that Lavoisier's system was more scientific than that of Stahl, and that Lavoisier was "the creator of the true method in chemistry." Claims of this character invariably carry a doubtful appearance, and even a general reader would hesitate to admit them. It is surprising that M. Wurtz, in his zealous and just endeavour to honour the memory of a truly great man, should estimate the labours and ideas of the ancients at so paltry a value; for, considering how little real novelty can be attributed with certainty to the French chemist, and how much he derived from his immediate and remote predecessors, Lavoisier himself is the only loser by the comparison. It must not be forgotten, however, that we are dealing with a traditional method. No sooner had Lavoisier formed in his own mind a clear conception of the plan he was about to pursue, and collected a few able associates around the regal standard, than he boldly named his system "French Chemistry." There was much art in that designation. In the first place he made interest with the vanity of his nation; in the second, he ignored antiquity; and, lastly, he thereby ensured the perpetuation of his personal fame. This title, however,—the sagacity of which we cannot but admire—was accompanied by a great deal of practical arrogance. Chemistry in France, instead of following its own natural development, was dispensed by a despot and his courtiers. In Germany the schools were insulted by the information that Stahl, their common and respected master, was destitute of common sense, and his theory of phlogiston a delusion; so that we cannot much wonder at the slowness with which the new system crossed the Rhine. In England it soon found powerful (and, perhaps, too partial) advocates, though even some of these were offended at Lavoisier's dictatorial manner and disingenuousness.

It has always been admitted, and we think with much correctness, that Lavoisier's achievements are all connected very intimately with the study of oxygen. No one could have better pointed out the logical value of his deductions, or the admirable sequence of his reasoning, than M. Wurtz has done in this volume. But we owe the discovery of oxygen to Priestley and Scheele; that it constitutes a part of the air, and is the one important agent both in combustion and calcination were facts known to Hooke [whose name is omitted from this chapter]. The increase in weight of metals when calcined had been acknowledged, we need hardly say, long before Lavoisier. Cavendish and Watt were the first to ascertain the composition of water. Black established the doctrine of latent heat (which is left unnoticed here). These are the essential, indeed the only, bases of Lavoisier's system. What, then, becomes of the statement that "chemistry is a French science?" Surely Davy was well warranted in saying "his discoveries were few, but he reasoned with extraordinary correctness upon the labours of others." Lavoisier's merit rests in the circumstance that he combined the scattered links which we have mentioned into a firm and single chain; not in the deceptive supposition that he inaugurated a new era. As an innovator he failed entirely. Few conceptions could be more gross or retrograde than that of oxygen as the acidifying principle, or (as he at one time conjectured) than that of nitrogen as the alkalising principle. It is clear, in fact, that the general acceptance of Lavoisier's system by his contemporaries depended on the very circumstance that it was, in its separate details, essentially old and not new.

We must not omit to notice the stress that many writers have laid upon the quantitative character of Lavoisier's experiments, involving, as it is commonly believed, the first introduction of the balance into chemistry. This fallacy is very well exposed by Mr. Watts, who, in a note at the end of the volume, gives a detailed account of Black's famous research on the nature of mild and caustic alkalies. Professor Wurtz, who is silent on this point, certainly mentions the memorable analyses of Wenzel, and the philosophic intention with which they were undertaken; but why the German chemist should be said to have "toiled in the dark" (*travaillait obscurément*) does not altogether appear, unless we are to allow that the brilliant Frenchman involved his contemporary in a total eclipse. Strictly speaking, the idea of weight does not possess so great a value as is commonly assigned to it, and a science of chemistry might very well exist without that idea as a factor. The broader and necessary conception of *number* was, in reality, and in this respect, what Lavoisier so eminently aided in announcing. That the notion of the indestructibility of matter even presented itself to his mind as a clear inference is very improbable, or, at least, an open question.

The study of the functions of oxygen had naturally led Lavoisier back to dualism; that is to say, he had re-established, but on a wider experimental basis, the fundamental conception which we owe to the iatro-chemists. Thoroughly conscious of the true value of language, he added to the maxims of Condillac the practical efforts of Morveau. Morveau was induced to abandon the phlogistic doctrine; a committee was appointed with Lavoisier at its head, and a nomenclature soon appeared from which the name of phlogiston was absent, and which embodied the spirit of the rising school. That nomenclature was undoubtedly a great success in its time, and its establishment was justified on principles to which few will deny either wisdom or foresight.

The idea of number soon assumed a very important phase in connection with chemistry. The law of multiple proportions, first observed by Higgins, and re-discovered by Dalton fifteen years subsequently, received, at the hands of the latter philosopher, an interpretation in accordance with the ancient notion of atoms. Higgins re-

presented these atoms as held together by mutual forces symbolised by lines. Dalton employed in his lectures a wooden sphere with radiating spokes. The modern notion of atomicity (if any clear notion really exists on such a subject) has, therefore, a somewhat remoter parentage than is commonly assigned to it. The announcement and gradual acceptance of the atomic theory mark especially an influx of materialism which has already reached its highest point, and is now commencing to recede from the steady shore of philosophic thought. M. Wurtz speaks strongly in praise of Dalton, whose name, he says, "is one of the greatest in chemistry," and points out, also, in this chapter the well-known relation between Gay-Lussac's great discovery and that of his English contemporary. The parts taken respectively by Avogadro and Berthollet on the latter question are also very clearly and excellently stated, but, perhaps, a little too briefly.

Berzelius adopted the atomic theory, but did not contribute to it any modification of serious importance. His quantitative work, though, doubtless, suggested by that theory, is, in its results, quite independent of any theory. Like Lavoisier's, his system was essentially dualistic, but his dualism was in many points different from, and superior to, that of his French predecessor, and had the advantage of reposing on a purer dynamics. The "binary theory," as it has been termed, was hardly ripe for discussion when a warm controversy took place between Berzelius and the French school led by Dumas. But we must refer the reader to M. Wurtz's book for a detailed and lively account of the campaign. The disorder, confusion, and misapprehension of the real question at issue have certainly not been surpassed in scientific history. Berzelius originated our present symbolic system, and the nomenclature which he had introduced, revived as it has been by Williamson, is gaining favour in this country.

The next chapter is devoted to an account of the doctrines of Laurent and Gerhardt. How far these great men, whose names will be for ever united in one dualistic formula, ever really adopted the atomic theory, is somewhat difficult to ascertain, and was, perhaps, unknown to themselves. That they protested against any representation of atomic arrangement is certain; but they adopted atomic language on many occasions. The doctrine of types and the numerical criteria of formulæ largely occupied their attention, but the idea of Gerhardt's "series" was borrowed from Avogadro.

M. Wurtz's final chapter is devoted to a lengthy discussion of the theories which prevail at the present day; their immediate origin and interdependence are pointed out with great clearness and force. It is stated, and with much truth, that these theories are essentially atomic; and the author, who has himself largely contributed to their success, of course heartily supports them. We do not propose to criticise them in this place, for such a procedure would hardly fall within the province of a contemporary reviewer, but content ourselves with warning students to suspend their judgment upon any corpuscular doctrine until they are really able to decide upon it for themselves. The influences of atomicism are so subtle that, if once committed to their acceptance, it is almost impossible for any mind to effect an escape.

We cannot, in conclusion, refrain from expressing our thanks to M. Wurtz for an account of chemical history in which, though some serious errors occur, there is so much to gratify and attract. The style is so lively and energetic, the argument so deductive, and the meaning so unmistakable, that we cannot help feeling how great a contribution has been made towards satisfying a real want of our time; and we commend the work to our readers with all the more confidence, because the editing and translation have been so judiciously executed. The notes which Mr. Watts has added are, moreover, evidences of the importance which he is well known to attach to an impartial statement of facts, and will serve to remedy some of the faults we have alluded to. Chemical literature in England owes a fresh debt to Mr. Watts, and we sincerely hope that his edition of M. Wurtz's *discours préliminaire* will aid in reviving a taste for a neglected but most important branch of literature.

CORRESPONDENCE.

EQUIVALENCE AND QUANTIVALENCE.

To the Editor of the Chemical News.

Sir,—As an admirer of the logical and very appropriate moderation evinced by the President in the discussion at the last meeting of the Chemical Society, I would moot that Mr. Ward's attack is not altogether in good taste; his long letter of nearly three columns is a reiteration of the "Hofmann" text without a single emendation or improvement. He may write grandiloquently of the all-important and momentous law of quantivalence; but Chemistry is making progress, and since the work of Hofmann newer and profounder treatises have appeared with admissions that may well justify the humble and cautious attitude referred to.

It is not true that the doctrine of equivalents only leads to the question *How much?* for it equally embraces the *How many?* Nor is it at all denied the full benefit of volumetric guidance, with all other physical and chemical aid.

What more does the momentous law of quantivalence provide? Mr. Ward says that N is trivalent. Mr. Equivalent says that in relation to H it is trivalent or triatomic; but is it so essentially or *per se?* Mr. Ward says not! Is the trivalent or "equiquantic" nitrous acid the most definite or stable of its oxy-combinations? Mr. Ward says not! Is this momentous law in any way the expression of chemical force or "chemism?" Mr. Ward says not!

Is S"O" equiquantic? Because, as that is the weakest of its principal forms of combination, peradventure quantivalence may be a law of weakness.—I am, &c.,

Chemicus.

MISCELLANEOUS.

On the Use of Tungstate of Baryta in Painting.—(Extract from a letter from M. Sacc to M. Dumas.)—"At the request of a landscape painter, I was induced to examine in succession all our insoluble white compounds, with regard to their adaptability to painting purposes. Tungstate of baryta answers perfectly, covers as well as white-lead, and as is unalterable as zinc white. It has been employed by this artist for three months, and was found equally successful in oil or water colours, chromolithography, and even in making white impressions on a black ground. This harmless substitute for the injurious white-lead is prepared on a large scale in Paris by M. E. Rousseau."

Extraction of Oxygen from the Air.—There is a competitor in the field now, in the shape of a process for extracting the oxygen from the air after the manner of the respiratory organs of animals. MM. Laire and Montmagnon propose to take advantage of the well-known property of wood charcoal, alkaline solutions, and blood of absorbing oxygen from the surrounding air, and condensing it between their molecules, either by a physical or chemical affinity. It is proved, by experiment, that 100 measures of wood charcoal, freshly burnt, absorb 985 of oxygen, and only about 705 of nitrogen. The blood of animals and solutions of phosphate and carbonate of soda absorb rapidly, according to the amount of surface exposed to the air, about 12 per cent of oxygen, and only two per cent of nitrogen. The proposed method of using

these facts is this:—Pump out the oxygen and nitrogen from the substances used to absorb it by means of an air-pump; pass the mixture through fresh-absorbing *media in vacuo*; re-extract, and repeat the operations as often as required. In this way an oxygen is obtained very free from nitrogen, and at an extremely cheap rate. The reservoir which contains the charcoal, &c., may be compared to the lungs of animals, and the air-pump to the pulmonary apparatus of the same nature. If this process should succeed upon a commercial scale, it will be a beautiful example of the imitation of one of nature's great processes, and its adaptation to the wants of man.—*British Journal of Photography*.

Astronomical Clock for Beauvais Cathedral.—Although not exactly belonging to the subjects the pages of our paper are devoted to, we abstract from the French journal *Les Mondes*, the following:—The clock is destined to be placed within the cathedral church; it is a piece of furniture constructed according to the designs of the Rev. Father Piérart, S.J., 12 metres in height, 5 metres wide, and 2 metres deep; it contains fifty-five dial plates, and indicates eighty different things; the internal work contains 90,000 parts. The clock indicates the exact time for twenty different parts of the globe, indicates also the precise moment of the rising and setting, and meridian passage of the sun and moon at Beauvais for every day of the year, and, moreover, the rising and setting of no less than 10,000 stars for the same place; besides this, other things, as saints' days, &c. At present the clock is at Paris, and may be seen in the Palais de l'Industrie; The entire work is highly spoken of, both as work of applied science and of fine art. The clock has been made, it appears, at the desire and expense of Magyar Grignoux, Bishop of Beauvais.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Effect of Heat on the Electromotive Force of the Galvanic Battery.—M. Crova.—(*Cosmos.*)—The results obtained by the researches of this author are the following:—(1) The electromotive force of the Daniell's element decreases regularly with an increase of temperature; (2) the electromotive force of a Grove's element increases with the temperature; (3) the electromotive force of an element wherein only one liquid is applied (Smee's) is independent of the variations of temperature.

Action of Light upon Chloride of Silver.—(*Les Mondes.*)—When freshly-precipitated chloride of silver (best obtained by means of decomposing a soluble silver salt with chlorine water) is placed in a white glass tube about 15 inches in length, and exposed to the action of direct sunlight, it will be observed that the chloride of silver remains quite white as long as the solution of chlorine water retains it greenish yellow colour; but as soon as that colour has vanished, the chloride of silver begins to decompose water under the influence of the direct rays of sunlight; the chloride gradually blackens, and and after a shorter or longer duration of time, the whole quantity will have become black, especially if care be taken to shake the tube now and then, so as to expose the whole mass to the light. When the tube is afterwards placed in a dark place entirely excluded from daylight, the black colour of the chloride of silver again disappears gradually, and the chloride becomes white; this experiment can be repeated over and over again with the same tube. The bromide, and probably also the cyanide of silver, behave in the same manner; the iodide of silver blackens only after having been rendered sensitive to light by pyrogallic acid.

Action of Sunlight on Glass.—M. Graffield.—(*Cosmos.*)—It is a well-known fact that, even independently from the effects of rain and wind, glass, even of good quality, is affected by sunlight. The late Dr. Faraday made some observations concerning this subject, and found that violet-coloured glass became deeper and more intensely coloured than it originally was after having been exposed to direct sunlight for eight months. M. Graffield, of Boston, U.S., who has been for more than twenty years in the wholesale glass trade, and is at the same time a good observer, has recently sent to the Photographic Society of Marseilles a series of the results of his researches and observations on this subject, in which he comes to the conclusion (which is especially important to photographers) that glass is even sensibly affected after one single day's exposure to the sun's rays, and that all glass, without exception, including that used for optical purposes, is more or less acted upon, even when made from the best materials and by most experienced workmen; greenish glass seems to become the least affected. The author has sent to Marseilles a series of photographs representing the tinge and changes produced in divers varieties and kinds of glass after exposing them to sunlight.

Adulterated Soap.—(*Les Mondes.*)—It appears that, in consequence of some complaints concerning the soap supplied at the thermal establishment at Amélie les Bains, this soap was analysed. Its colour was greyish; odour very disagreeable (especially when recently cut); to the touch it was peculiarly greasy, causing a biting sensation at the same time. It was readily soluble in distilled water, producing a good lather, but the solution produced a biting pain when brought into contact with the hands. In 100 parts, the soap contained 29 of alkali and 19 of tallow; no wonder, therefore, of its effects on the skin, and complaints in consequence thereof.

Oxyhydrogen Light.—Reduction of Earthy Metals.—The learned Abbé Moigno, while referring to this subject in *Les Mondes*, says, our readers will undoubtedly learn with pleasure that the production of oxygen in cheap manner from manganate of potassa and of pure hydrogen, by means of a hydrocarbon fuel (*combustible hydrocarboné*), on the large scale, has become a decided success; that, moreover, the reduction of the earths baryta, magnesia, and alumina to the metals barium, magnesium, and aluminium, by means of hydrogen under high pressure and a very high temperature, is successfully carried out; while, lastly, M. Caron has succeeded in obtaining, by means of great perseverance, zircon-magnesia cones, which, instead of being very breakable and only lasting for a few nights, are fit for use for any length of time.

Brittleness of Bones.—(*Les Mondes.*)—Professor Hofmann, at Prague, has recently analysed bones of cattle, some of which were derived from healthy animals, others, again, from animals which during life had been affected with fracture of bones consequent upon their great brittleness; while the composition of the former was normal, that of the latter proved to be abnormal, by containing a far greater proportion of carbonates and phosphates of lime and magnesia, while, at the same time, the nitrogen contained in the organic matter of the bone was considerably less than it should be; hence the Professor advised that, as a remedy in such cases, food richer in nitrogenous substances should be administered to the cattle.

Platinising Copper, Yellow Metal, and Brass.—(*Les Mondes.*)—In order to obtain the platinising fluid, add, to a moderately-concentrated solution of chloride of platinum, finely-powdered carbonate of soda until effervescence ceases, next some glucose, and afterwards just so much common salt as will cause a whitish-coloured precipitate. When it is desired to apply this mixture for platinising, the objects to be treated are placed in a vessel made of zinc and perforated with holes; the vessel is then placed, with its contents, for a few seconds into the mixture just described, which, just previous to using, should be heated to 60° C. On being removed from the zinc vessel, the objects are to be washed with water and dried in sawdust.

Researches on Materials fit for Resisting very High Temperatures.—M. Audouin.—(*Cosmos.*)—While engaged with other studies on geology in the southern parts of France, the author found that between Tarascon and Antibes there exists a very valuable and extensive bed of *bauxite* (hydrate of alumina), which is occasionally applied for the manufacture of sulphate of alumina. This material has been applied, at the suggestion of Audouin, for the manufacture of crucibles and fire-bricks; and on having been tested in comparison with the best products of the kind from France, England, and Germany, it was found that even best fire-bricks might be melted in bauxite-made crucibles heated by mineral oils and a blast.

Synthesis of Paramonochlorobenzoic Acid.—(*Zeitschr. f. Chem. v. Beilstein.*)—Carl Müller has instituted, in the laboratory of Dr. Carius, at Marburg University, some researches on this substance. He found that paramonochlorobenzoic acid originates when chloride of benzol, C_4H_2Cl, is oxidised by the action of moderately dilute sulphuric acid and peroxide of manganese; a number of other products are simultaneously formed—among these, chiefly formic acid. Paramonochlorobenzoic acid is a solid substance, fusible at 235° C., readily soluble in alcohol and ether, but difficultly so in water; one part of the acid requires 5288 parts of water for solution. The acid crystallises both by sublimation and from its alcoholic solution; the composition of its baryta salt is—

$$C_{14}H_8Ba''Cl_2O_4+(OH_2)4.$$

Its formation from chloride of benzol may be expressed by—

$$C_6H_5Cl+CH_2O_2+O=OH_2+C_6H_4Cl,CO,HO.$$

On the Solubility of Difficultly-Soluble Compounds in Aqueous Solutions of Sugar.—(*Zeitschr. f. Chem. v. Beilstein.*)—Dr. Jacobsthal has instituted a series of experiments on this subject, in order to ascertain the presence of various salts and their bearing upon the manufacture of beet-root sugar. The author experimented with the sulphate, carbonate, oxalate, citrate, and basic phosphate of lime, and the carbonate of magnesia; quantities of these salts in excess were placed in solutions of pure sugar in distilled water, containing respectively 5, 10, 15, 20, and 30 per cent of sugar. The salts were placed in flasks, heated for awhile on a water-bath, and left standing for from four to five days, care being taken to replace any water which might have evaporated, and also to shake the flasks daily for some time; the solutions were then filtered, and in the clear filtrate the quantity of salt dissolved was determined. The results obtained are exhibited in a tabular form, which represents—(1) the quantity of the various salts is dissolved in 1000 c.c. of the different sugar solutions; (2) the quantity of the salts which would have dissolved in the water present in the various sugar solutions, deducting the quantity of water required to keep the sugar respectively therein contained dissolved. It appears that the more a sugar solution is concentrated, the less it is capable of dissolving the salts experimented upon; the carbonate of magnesia is the only salt which makes an exception upon this rule; the results agree with some observations made by Cunze, who witnessed the separation of oxalate of lime from a sugar solution on becoming concentrated from 5 to 30 per cent.

Adulteration of Sulphuric Acid.—(*Rev. Hebd. de Chim.*)—It appears that some Continental makers of this acid are in the habit of adding to ordinary chamber acid a sufficient quantity of some cheap acid sulphate, so as to bring the sulphuric acid, as far as hydrometrical tests are concerned, up to the desired degree of density. M. Fleischer, having cause to complain about the bad quality of indigo-carmine prepared with a certain sample of sulphuric acid, was induced to evaporate some of the acid, and on doing so discovered the formation of crystals of sulphate of soda. This kind of adulteration, however readily detected, might cause in many dye and madder and garancine works very serious loss and great inconvenience, and is a gross fraud; the inducement is the saving of the cost of evaporation and apparatus connected therewith.

On the Constitution of Glucina.—(*Zeitschr. f. Chem. v. Beilstein.*)—Dr. G. Klatzo has written, at Dorpat University, an essay on this subject, and conducted a series of experiments with oxide of glucinum, and prepared a large number of salts and double salts of this base. He has made several analyses of sulphate of glucina, and calculated from the results thus obtained the percentage of oxygen contained in the glucina at 63·425 per cent, the atomic weight of BeO at 25·227, and the atomic weight of Be at 9·227. As general results of his researches, the author states—1st, that glucina is in every respect a base similar to magnesia, which it can displace without change of crystalline form and quantity of water of crystallisation; 2nd, the sulphates of glucina, heated to 150° C., still retain one atom of water, which, as is equally the case with magnesia salts, can be displaced by sulphate of potassa; 3rd, like magnesia and oxide of zinc, glucina crystallises from its solution in excess of water saturated with carbonic acid, and yields a neutral crystalline carbonate, capable of forming, with the carbonates of the alkalies, perfectly crystallising double salts.

NOTES ON LECTURE EXPERIMENTS.

Colouring Carbonic Acid.—Carbonic acid may be coloured brown by nitrogen peroxide. This gas is easily obtained by heating lead nitrate in a test-tube, and by means of a bent tube, conducting the brown fumes into the vessel containing the carbonic acid. Bromine vapour may be used, but the smell is very disagreeable. A simple method of rendering carbonic acid visible is that described by Priestley—"Experiments and Observations on Different Kinds of Air," 3rd edition, 1781, pp. 25-6—viz., by extinguishing lighted candles, paper, &c., in the gas, when the smoke clings to it, rendering it visible. If gunpowder be fired in a large vessel filled with carbonic acid, the smoke, as stated by Priestley, scarcely escapes from the vessel; and, on tilting the vessel thus charged with carbonic acid and smoke, the pouring out of the gas is rendered distinctly visible even from long distances, forming, as a friend of mine used to say, a "*gascade*."—C. J. WOODWARD, Midland Institute, May 3rd, 1869.

Hydrogen Bottle.—Thin sheet-lead is worked into the shape of a round bottle, with a wide neck to hold a cork; a gas-cock in the dome or neck of the bottle. Before joining the bottom, a perforated tray of lead is inserted, about 2 inches up into the bottle. A short bit of lead pipe (½ inch) opens into the bottle below. The first idea proposed a cylindrical chamber, fastened to the bottle towards the top, and communicating, by pipe, with the opening below. Into this chamber the liquid is forced by the gas. The suggestion of this year is simple—To put the bottle into any vessel with acid solution. A large quantity of granulated zinc may be put on the tray. This, and the bottle being of lead, galvanic action promotes the evolution of gas, which forces out the liquid, &c., as in the hydrogen lamp. I used the bottle in the simple form this year, and found it all that could be desired. Even the cleaning is easily done. The oxide and sulphate fall through the tray to the bottom and wash out.—RICHARD MC.NEVIN; EDWARD CANNON (1862). CHRISTOPHER DUNN (1869), Clongowes.

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

368. H. A. Dufrené, Rue de la Fidélité, Paris, "Improvements in the manufacture of ice and of the agents employed therein, and in the apparatus connected therewith."—A communication from C. Tellier, Paris.—Petition recorded February 6, 1869.

1083. J. Dewar, M.D., Kirkcaldy, Fifeshire, "Improvements in treating certain substances for food and for manure.—April 9, 1869.

1103. E. C. C. Stanford, Glasgow, N.B., "Improvements in applying, treating, and utilising materials for deodorising solid, liquid, and gaseous matters."—April 10, 1869.

1151. W. Wright, Mostyn, Flint, "Improvements in treating ores to obtain copper and other metals therefrom."—April 14, 1869.

1197. H. Aitken, Falkirk, N.B., "Improvements in treating iron ores or iron stones."—April 19, 1869.

1203. A. Brady, Stratford, Essex, "Producing pure iron direct from crude iron ore."—A communication from E. Brady, Philadelphia, Penn., U.S.A.—April 20, 1869.

1224. M. Henry, Fleet Street, London, "An improved mode of obtaining pyro-phosphate of lime."—A communication from E. Deligny, Boulevard Saint Martin, Paris.

1227. C. D. Abel, Southampton Buildings, Chancery Lane, "A new or improved method of, and materials for, the preparation of mural paintings."—A communication from P. Oury and P. Cousin, Rue de Trois Freres, Paris.—April 21, 1869.

1244. A. Borgnet, Swansea, South Wales, "Improvements in the manufacture of paint."—April 22. 1869.

INVENTIONS PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

1290. S. Oakman, Boston, Mass. U.S.A., "Improvements in the construction of smelting and other furnaces."—Petition recorded April 26, 1869.

NOTICES TO PROCEED.

3837. G. Hadfield, Lancaster, "Improvements in the manufacture of varnish."—Petition recorded December 17, 1868.

3830. C. Liebermann and C. Graebe, Berlin, Prussia, "Improvements in preparing colouring matters."—December 18, 1868.

3870. P. Spence, Newton Heath, near Manchester, "Improvements in the manufacture of alum and aluminous salts."—December 19, 1868.

3893. W. E. Gedge, Wellington Street, Strand, Middlesex, "A novel bituminous composition."—A communication from F. Labat and J. Meric, Boulevard Bonne-Nouvelle, Paris.—December 21, 1868.

375. C. D. J. Seitz, Bury, Lancashire, "Improvements in the construction of furnaces and pans for the recovery of the soda from the waste lyes resulting from the boiling of esparto grass, straw, or other fibrous substances, in the working and incinerating of the residue resulting from evaporation."—February 6, 1869.

600. J. Townsend, Glasgow, N.B., "Improvements in extracting and in refining oils and other products from mineral and other materials containing carbon and hydrogen, and in apparatus therefor."—February 26, 1869.

969. G. Wells, Westminster, "Improvements in separating copper and bismuth from ores containing metals either separately or combined with other metals."—A communication from T. Y. Cotter and C. L. Dubois, Adelaide, Australia.—March 31, 1869.

NOTES AND QUERIES.

Chemical Infinity.—*Appleton's Journal* contains in its first number a calculation by Berthelot, the eminent French chemist, of the number of combinations which may be made of acids with certain alcohols. He says, if you give each compound thus possible a name, and allow a line for each name, and then print 100 lines on a page, and make volumes of 1000 pages, and place a million volumes in a library, you would want 14,000 libraries to complete your catalogue.

The Gulf Stream.—Captain Maury considers the Gulf Stream equal to a stream 32 miles broad and 1200 feet deep, flowing at a rate of 5 knots (38,415 feet) an hour. This gives 6,166,700,000,000 cubic feet per hour as the quantity of water conveyed by this stream. Sir John Herschel's estimation is still greater; he considers it equal to a stream 30 miles broad and 2200 feet deep, flowing at the rate of 4 miles an hour; this makes the quantity 7,359,900,000,000 cubic feet per hour. Sir John estimates the temperature of the water at 86° F.—*Engineer.*

Carbonic Acid.—Mr. Kernan evidently forgets that common washing soda contains—(1) more than half its weight of water of crystallisation, and (2), unless purposely purified, is contaminated with some undecomposed chloride of sodium and sulphate of soda, containing, moreover, caustic soda; the substance being, moreover, soluble in water, is not so well adapted also on economical grounds for the production of carbonic acid gas as is white marble, or any other lime-stone, which, weight for weight, will yield more gas than the common washing soda. Of course it may be used, but it has no advantage.—Dr. A.

An Excellent Indelible Ink may be prepared by rubbing up 1 drachm of aniline black with a mixture of 60 drops of concentrated hydrochloric acid and 1½ ounces of alcohol. The resulting deep blue liquid is then to be diluted with a hot solution of 1½ drachms of gum-arabic in 6 ounces of water. This ink does not corrode a steel pen, and is effected neither by concentrated mineral acids nor by strong lye. If the aniline black solution be diluted with 1½ ounces of shellac, dissolved in 6 ounces of alcohol, instead of with the gum-water, an aniline black is obtained, which, after being applied to wood, brass, or leather, is remarkable for its extraordinary deep black colour.—*American Artisan.*

Supply of Water for Domestic Purposes.—From a brief report of the proceedings of the Municipal Council of Nismes, France, we copy the following figures, indicating the quantity of potable water supplied daily in litres to the under-mentioned places for each head of inhabitants:—

		litres.
	Ancient Rome	1500
	Rome of present day	900
	New York	360
France.	Carcassonne	400
France.	Besançon	270
France.	Dyon	270
France.	Bordeaux	170
	Paris, at present	125
	" in 1871	250
	London	95
	Lyons	85
	Brussels	80
	Genève	74
	Nismes	200

Action of Heat on Peroxide Salts of Iron.—The observation of M. Debray, reported in your last issue, on the action of heat upon the peroxide salts of iron, explains a matter that I have almost invariably noticed for several years past, in testing commercial sulphate of soda, or salt-cake. As manufactured on the large scale, this substance always contains a small amount (from 0·25 to 0·5 per cent) of the sulphate of peroxide of iron, and, when dissolved in cold water, forms a colourless solution, even when concentrated. If hot water be used, or if the cold solution be gradually heated, it immediately becomes quite brown-coloured, and particles of hydrated peroxide of iron are observable, the static equilibrium having been in this case disturbed by the sulphate of soda present.—BRISTOWE.

"**How to Prevent the Spread of Scarlet Fever.**"—As far as it has been possible to ascertain, the miasma of scarlet fever, *febris scarlatina maligna*, is a fixed contagium, not volatile, nor to be met with at a distance from the patient who, while suffering from the disease, produces the peculiar miasma, about the real nature of which, be it a germ, or something else, nothing is precisely known; it is, however, a fact that keeping disinfectants in the locality where a patient suffering from the disease is confined, is beneficial as a prophylactic for those attending upon him. Green copperas, sulphate of protoxide of iron, would not be so fit to use in this special case as sulphurous acid, hypochlorite of lime, or carbolic acid. Green copperas may disinfect drains and cess-pits, but would be of little avail in this particular case, the less so as the evident proof has not been given that scarlatina is propagated in the way spoken of by "Sanitas." This discussion should rest here, as it is not one to which the columns of this paper are open, being a purely medical subject.

MEETINGS FOR THE WEEK.

TUESDAY, 11th.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."
—— Photographic, 8.
WEDNESDAY, 12th.—Society of Arts, 8.
—— Geological, 8.
—— Microscopical, 8.
THURSDAY, 13th.—Royal Institution, 3. Professor Tyndall, "On Light."
—— London Institution, 6.
—— Royal Society, 8.30.
—— Zoological, 8.30.
—— Royal Society Club, 6.
FRIDAY, 14th.—Royal Institution, 8. Mr. Perkin, "On the Newest Artificial Colouring Matters."
SATURDAY, 15th.—Royal Institution, 3. Prof. Seeley, "On Roman History."

TO CORRESPONDENTS.

*** We shall feel indebted to correspondents who will forward us Reports of Local Meetings of Societies, Chemical Appointments, and any other subjects interesting to the chemical world. We regret that, owing to the increasing popularity and circulation of the CHEMICAL NEWS, and consequent pressure on our space, we are often obliged to delay the publication of long papers. To those correspondents who wish to favour our readers with Notes of New Discoveries, Descriptions of Apparatus, or Answers to Questions, we would especially recommend our Notes and Queries columns.

ERRATUM.—Page 204, column 1, 6th line from top, for (2) 951 read (2) 634, and for (3) 1032 read (3) 688.

W.—The treatise mentioned by you on water analysis is excellent; you can, if so inclined, purchase from Messrs. Griffin all the apparatus and test liquids, ready made, adapted for use according to the directions of this book. As to sewage, there does not exist any special treatise on the analyses thereof, but in Fresenius's and Noad's works on "Quantitative Analysis" you will find every information you may require to enable you to analyse what you desire. Your letter will appear next week.

A Subscriber since January.—Mr. Little's letter "On the Estimation of Phosphates," in No. 434 of the CHEMICAL NEWS, will probably give the information you require.

W. J. Morgan.—You will find a good chapter on the use of the spectroscope in the last edition of Fresenius's "Quantitative Analysis." A book on the subject will shortly be published by Macmillan.

Tincture.—If you intend to sell it as a proprietary medicine it will certainly require the medicine stamp. By sending particulars to the Board of Inland Revenue, Somerset House, you will receive full information on the subject.

E. K.—The description of the apparatus is received, with thanks; we are always glad to have notes of novelties or improved apparatus. The yellow, red, and green lines shown by sodium, lithium, and thallium in the spectrum microscope are true lines, not bands. A band is not generally sharp at the edges, and is wider than the image of the slit. Your difficulty is probably more apparent than real, still we should like to see Father Secchi's answer to your question. The description of the battery was too complicated, and required too many cuts to enable it to be given in our pages; it was, however, of use to one or two correspondents. Hofmann's report on the aniline colours at the Paris Exhibition is given as a supplement to the English edition of Reimann's "Aniline." The book can be obtained at our office.

E. C. C. S.—The paper as last sent will be inserted next week; the second paper will follow.

Paper's questions cannot be answered without going into details, which must be fully discussed. A letter is waiting for him at our office.

Communications have been received from Dr. H. Lawson; E. Kernan; J. Emerson Reynolds; K. Weaver; H. Hudson; W. L. Spiers; F. M. Jenning; Messrs. Townsend and Adams; Hugh Munro; Jones, Bros., and Co.; R. Spice; G. H. Ogston; E. W. Streeter; L. Demuth and Co.; J. Simpson; S. and E. Collier; Morgan and Davies; J. Mosley (with enclosure); C. Tomlinson, F.R.S.; G. F. Rodwell; Street, Bros.; J. Browning; A. Norman Tate (with enclosure); J. Denman (with enclosure); J. Bagueley; A. B. Fleming and Co.; Dr. T. Wood: J. Coupland (with enclosure); S. E. Phillips (with enclosure); P. Squire (with enclosure); Longmans and Co.; W. A. Murray; H. Stephenson; R. Mallet, F.R.S.; H. Rey; Dr. Rühig; Dr. Goedicke; E. C. C. Stanford (with enclosure); P. Finnegan; G. Preece; H. Crossley; and F. Ritchie and Sons (with enclosure).

BOOKS RECEIVED.

Laboratory Teaching; or, Progressive Exercises in Practical Chemistry. By Prof. C. L. Bloxam. London: Churchill and Sons.
Pure Wine, and how to Know it. By J. L. Denman.

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THE CHEMICAL NEWS.

VOL. XIX. No. 493.

ON A NEW METHOD OF

ESTIMATING THE REDUCED PHOSPHATES OF LIME, MAGNESIA, IRON, AND ALUMINA,

IN SUPERPHOSPHATES OR MANURES.

By J. A. CHESSHIRE.

ATTENTION having been called this season to what is termed the going back, or the reduction, of the soluble phosphates into insoluble phosphates in superphosphates, as an analytical chemist at a manure works in the midland counties (Bradburn and Co., Wednesfield, near Wolverhampton), I have been required to estimate the reduced phosphates so formed. The plan now in use—viz., boiling with citric acid—is, I have found, not to be relied upon, as I have partially dissolved ground coprolite in this acid. The way that I am in the habit of doing is this.

Take about 1½ grammes of superphosphate, extract the soluble part with cold water, and, afterwards, with boiling water; wash the insoluble residue on the filter into a beaker, boil for about half an hour with oxalate of ammonia and about two drops of oxalic acid, so as to have a slight acid reaction; this I do in order to keep the phosphate of magnesia in solution. Then filter; the filtrate contains the phosphates of lime and magnesia, and, perhaps, a little phosphate of iron and alumina. To the filtrate add tartaric acid, ammonia, and the magnesia mixture, weigh the precipitate, and estimate the phosphoric acid as $Ca_3(PO_4)_2$; the insoluble residue on the filter, from the reduced lime and magnesia, wash into a beaker, boil for about one hour with sulphide of ammonium and a few drops of ammonia, filter, &c.; to the filtrate add the magnesia mixture, and calculate the results in the same manner as the reduced phosphates of lime and magnesia.

I may add, that the reduced phosphates so formed are quite equal, in money value, to the soluble phosphates.

ON THE

SOURCE OF FREE HYDROCHLORIC ACID

IN THE

GASTRIC JUICE.*

By Professor E. N. HORSFORD, Cambridge, U.S.A.

FOLLOWING up the researches of Prout, C. Smidt, Lassaigne, Tiedemann and Gmelin, Berzelius, Blondlot, Claude Bernard, Schwann, and others, the author endeavours to determine how free hydrochloric acid can be secreted from the blood, which is an alkaline fluid. He assumes that in healthy digestion, as a consequence of increased flow of blood to the gastric mucous membrane, and of the normal elasticity of the walls of the capillaries, there exists in the membrane a condition which is the equivalent of engorgement. Under the pressure which attends this condition, the corpuscles in contact with the walls of the capillaries would discharge a portion of their acid contents, which, with the adjacent plasma, would pass through the walls of the capillaries. This mixture would contain acid phosphates and chlorides.

By endosmose and osmosis, a portion of this fluid will pass through the walls of the gastric tubes; and, to determine whether the fluid that goes through contains free hydrochloric acid, the author employed an acid phosphate of lime of specific gravity 1·117, of a constitution of $3(CaOPO_5)+2PO_5$, with an amount of phosphate of peroxide of iron present as one to twenty-eight of the acid phosphate of lime. The various other solutions employed were the ordinary laboratory reagents.

On adding ammonia in small quantities to the solution of acid phosphate, with alternate agitation, it required several repetitions before the peroxide with its phosphoric acid became a permanent precipitate, and still several more before the precipitate of phosphate of lime became permanent.

The experiments were made with parchment-paper, prepared from German and Swedish filter-paper, as well as with goldbeater's skin (animal membrane).

He employed acid phosphate of the formula above, with (each by itself) chloride of sodium, chloride of ammonium, chloride of potassium, chloride of calcium, and chloride of magnesium.

The author also experimented with acetate of potassa and acid phosphate of lime.

With all these there was obtained the same kind of evidence of increased acidity on one side, and of increased alkalinity on the other, to wit, the powder thrown down from the mixture of acid phosphate and chloride. What successive additions of ammonia had been required to effect had been accomplished by dialysis.

The same effect took place from a mixture of acid phosphate of soda and chloride of calcium.

It follows from the above, if these experiments fairly represent the case, and from the known composition of the blood, its condition in the walls of the stomach, and the structure of the gastric tubules, that free or uncombined hydrochloric acid must find its way into the bottoms of the gastric tubules, and thence into the cavity of the stomach.

The secretion of hydrochloric acid is mixed with acid phosphates and alkaline chlorides.

The author therefore states that, whatever other peculiarities the blood corpuscles may possess, they have the requisites for furnishing acid phosphates in solution under pressure, such as must attend engorgement of the capillaries in the walls of the stomach; that, in all probability, as the acid fluid enters the gastric tubules, they are surrounded by a mixture of hydrochloric acid, acid salts, neutral salts, and albumenoid bodies. Dialysis must be repeated, and a stronger acid solution pass into these sacs. The sacs, swelling by endosmosis, and corroded by the acid, must at length burst, and the liquid contents, together with the disintegrated and partially-digested membrane of the sacs, pass out into the stomach, to constitute the gastric juice; the free hydrochloric acid, acid phosphates and chlorides, and the albumenoid bodies and disintegrated tissue (*the pepsine?*) to act in the liquefaction of food.

* Abstract of a paper read before the Royal Society, April 15th, 1869.

ON A CERTAIN

EXCRETION OF CARBONIC ACID BY LIVING PLANTS.*

By J. BROUGHTON, B.Sc., F.C.S.,

Chemist to the Cinchona Plantations of the Madras Government.

WHILE the author was engaged in some experimental determinations of the changes that take place in the composition of the Cinchona barks after being taken from the tree, he noticed a somewhat singular circumstance, which induced him to institute a series of experiments, by which he discovered that the various parts of living plants excrete carbonic acid, not only in their normal condition, but after they have been deprived for days together of all access of oxygen. The experiments were mostly made on cut portions of the plants, but experiments were also made for control, on plants as they actually grow. The

* Abstract of a paper read before the Royal Society, April 28th, 1869.

deprivation of oxygen was effected sometimes by Sprengel's air pump, sometimes by substituting for air an atmosphere of hydrogen or nitrogen, while comparative experiments were made on plants supplied with air that had been freed from carbonic acid. The main conclusions to which he was led are those enunciated by the author:—

1st. That nearly all parts of growing plants evolve carbonic acid in considerable quantities, quite independently of direct oxidation.

2nd. That this evolution is connected with the life of the plant.

3rd. That it is due to two causes, namely, to previous oxidation, resulting after a lapse of time in the production of carbonic acid, and to the separation of carbonic acid from the proximate principles of the plant while undergoing the chemical changes incident to plant-growth.

THE ELLERSHAUSEN PROCESS OF REFINING IRON.

The recent invention of Mr. Ellershausen, which is now regularly in use in Pittsburg, Pa., and is being rapidly introduced all over the country, has greatly advanced the solution of the problem of cheap iron.

The process consists in the conversion of crude cast-iron, as it runs from the smelting furnace, into wrought-iron, by the simple admixture of pulverised iron ore. It is carried out at the works of Messrs. Shoenberger, at Pittsburg, in the following manner:—On the casting floor of the smelting furnace, a cast-iron turn-table, about 18 feet diameter, is revolved on rollers by a small steam-engine. Upon the outside edge of the table stand a row of cast-iron partitions, forming boxes, say, 20 inches wide and 10 inches high, open at the top. Just above the circle of boxes stands a stationary, wide-mouthed spout, terminating in the tap-hole of the furnace. When the furnace is tapped the liquid iron runs down this spout, and falls out of it in a thin stream into the boxes as they slowly revolve under it, depositing in each a film of iron say one-eighth of an inch thick. But before the fall of melted iron reaches the boxes it is intercepted, or rather crossed, at right angles, by a thin fall of pulverised iron ore, which also runs out of a wide spout from a reservoir above. These two streams or falls are of about equal volume, say one-quarter of an inch deep and 20 inches wide. A workman, with a bar in the tap-hole, regulates the streams of iron, and the iron spout from which the liquid metal falls into the boxes is removable; other spouts, previously coated with loam and dried, being attached to a common revolving frame, so as to be ready for use when the loam covering of the first becomes cracked or removed.

The thin layers of iron and ore soon chill and solidify, so that by taking away the outer partition of the boxes (which form the rim of the turn-table) they may be removed in cakes of the size of the boxes and weighing about 200 pounds each. Four of these cakes or blooms are put into a reverberatory puddling or heating furnace, and raised to a bright yellow heat. They will not melt at this heat, but become softened so as to be easily broken up with a bar. The four blooms are formed in the furnace by the "rabble" of the workmen, as in ordinary puddling operations, into eight balls. The balls are brought out one after another, squeezed in the ordinary "squeezers" to expel the cinder and superfluous ore, and then rolled into wrought-iron bars, which are now ready for market, or for further reduction into smaller finished forms.

The chemistry of the operation is as follows:—The crude cast-iron contains, say, 5 per cent of carbon, and 3 per cent of silicon, and more or less sulphur, phosphorus, and other impurities. In the Bessemer process the oxygen of the air, blown into the liquid iron, combines with this carbon and these other impurities, and not only removes them but leaves the pure iron in a liquid state, from which it can be cast into homogeneous masses of any size. In the puddling process, the oxygen of the air and of the ore or other "fettling" put into the furnace with the iron combines with and eliminates the impurities, which are afterwards squeezed out of the pasty mass by the squeezers and rolls. This process is long and comparatively expensive, because the mixture of oxygen or oxygen-bearing substances is not made intimate with the iron except by long stirring, which is not only skilful but exhausting work.

In the Ellershausen process the oxygen of the ore or oxide of iron (manganesic oxide is preferred) combines with the carbon and impurities, eliminating them as in the puddling process, and the iron of the ore increases the product. The chemical combination of the ore and the liquid crude iron appears to take place partly at the time of their contact when falling and lying upon the turn-table, and partly where the re-heating occurs in the furnace. It seems impossible that a reaction which is so violent in the Bessemer process, and so prolonged in puddling, should take place so quickly and quietly in the new process, but the fact that the cakes of iron and ore do not melt by subsequent heating, as cast-iron would, proves that its nature is changed by the first contact of the ore. The removal of sulphur and of phosphorus also seems more thorough than in the other processes. Analyses at different stages of the operation will throw more light on this question.

The remarkable feature of the Ellershausen process is that absolutely no skill is required to carry it out. The proportion of ore mixed is intended to be about 30 per cent, but if too much is added, it is readily squeezed out with the slag, and seems to do no harm. The subsequent heating occupies about half an hour. "Puddle-bar," the product obtained from the first rolling of the product of the puddling furnace, is never marketable or finished iron. It is usually very ragged and unsound, and requires subsequent piling, re-heating, and re-rolling, to expel the impurities, and to give it soundness and solidity. The new process appears to produce merchantable iron at the first rolling, and at Pittsburg, from a very inferior pig-iron made of one-half sulphurous Canada ores, and one-quarter Lake Superior and one-quarter Iron Mountain ores.

The thoroughness and rapidity of the purification by this process evidently depend on the intimacy of the mixture of iron and ore. This intimate mixture is also the essence of the Bessemer process. In fact, to Mr. Bessemer's original apprehension of this idea of intimate mechanical mixture the greatest modern improvements in the iron manufacture are due.

The Ellershausen process is said to decrease the cost of wrought-iron from 10 dollars to 20 or 30 dollars per ton, according to the materials used and the form of the product required. That it is a success is amply proved by regular working at Pittsburg and many experiments elsewhere.—*American Artisan.*

DR. LETHEBY, ON THE METHODS OF WATER-ANALYSIS AND ON SEWAGE CONTAMINATION.

A few weeks ago Dr. Letheby read a very important paper to the Metropolitan Association of Medical Officers of Health, entitled "On the Methods of Estimating Nitrogenous Matters in Potable Waters, and on the Value of the Expression 'Previous Sewage Contamination,' as used by the Registrar-General in his Monthly Reports of the Metropolitan Waters." The discussion which followed it was very animated, and was so long that an adjournment for a fortnight was found necessary. In this interesting paper, Dr. Letheby attacked with great warmth the methods of analysis employed by Dr. Frank-

land, the deductions which the latter chemist thinks himself justified in making from the results of his analysis, and in particular the well-known calculation of "previous sewage contamination" from the nitrogen found as nitrates, nitrites, and ammonia in the water. He described the methods in which he himself places reliance—methods which need not be recapitulated here because they are familiar to almost all chemists — and in contrast with them recited a formidable list of the difficulties and errors to which, he asserted, Frankland and Armstrong's methods were liable. This part of the subject, important though it be to chemists, we do not propose to discuss in any detail at the present time, reserving it, if need be, for a separate consideration hereafter. The combustion process, by which Dr. Frankland estimates the organic carbon and nitrogen of a water, is, to judge from the trial experiments, very greatly more accurate than any that has hitherto been suggested for the determination of organic matter. Both the absolute and percentage errors observed in the trial experiments were, indeed, marvellously small, considering the extraordinary difficulties to be encountered. Dr. Letheby appears to rely mainly upon the permanganate test, and calculates the amount of organic matter in the water by multiplying the oxygen-indication by eight. This calculation is founded on a comparison between the indications of the test and those of the old incineration method; but as the latter has long been known to be worthless, and as Dr. Letheby himself has abandoned its use, it is difficult to see how the calculation can give even an approximation to correctness. Every one of our readers is, moreover, aware that the oxidising power of the permanganate varies extremely in different cases; that of nine kinds of organic matter examined by Frankland and Armstrong, one—viz., oxalic acid—was completely oxidised by it, even in six hours; that urea, hippuric acid, and creatin were scarcely oxidised at all, while the mineral, sodic nitrite, was oxidised instantaneously.

These considerations are, however, somewhat irrelevant upon the present occasion, for Dr. Letheby does not seriously impugn the accuracy of the method by which Frankland and Armstrong effected the determination of the nitrogen present as nitrates and nitrites, and agrees with the latter chemists in employing the Nessler test for the determination of ammonia. It is from these compounds that the previous sewage contamination is calculated, and it is to this calculation that the criticism of Dr. Letheby is mainly directed. The ammonia present in potable waters is generally a small quantity, and we may therefore assume, for the purpose of the present discussion, that the previous sewage contamination is entirely deduced from the nitrates and nitrites of the water. Dr. Letheby does, indeed, impugn the accuracy of the correction made by Dr. Frankland for the nitrogen introduced by rain; but this makes little real difference, for even if the estimate of Lawes, Gilbert, and Way be adopted, and the river be assumed to contain the whole quantity of combined nitrogen found by those chemists in the rain of Rothamstead, without a grain having been removed by vegetation, the deduction would only be equal to 985 parts in 100,000 of previous sewage contamination, instead of 320, a difference equal to less than one-fifth of the amount frequently attributed to some of the London waters in the Registrar-General's returns.

Divested in this manner of collateral issues, the arguments of Dr. Letheby may be reduced to a few simple propositions. He maintains, in the first place, that the nitrates and nitrites of potable waters are not due solely to the oxidation of animal matters, but are frequently derived from other sources, and that therefore it is fallacious to use them as a measure of previous animal contamination. Under any circumstances, moreover, they could not be an accurate measure, because the process of vegetation is constantly removing them from waters exposed to its action, and it consequently happens that waters known to have received sewage contamination are sometimes found to contain scarcely any oxidised nitrogen, while others which, it is alleged, cannot have received any such contaminations contain much. A good illustration of this apparent anomaly was quoted by Dr. Letheby. In the months of July, August, and September, 1868, the water supplied by the Kent Company, and derived by them from deep chalk wells, was described by the Registrar-General as exhibiting a previous sewage contamination of 3660, 3660, and 3530 parts in 100,000; while that of the East London Company, derived from the sewage-contaminated Lea, was returned for the same months as 0, 0, and 20.

It is furthermore urged by Dr. Letheby that it is unfair to describe by a name calculated to produce disgust and alarm, a contamination which, whatever its source, has been oxidised and rendered innocuous in the water. Sewage diluted with twenty parts of water is, he asserts, entirely destroyed in the course of a run of ten or twelve miles down a river, and it is therefore impossible for mischief to arise from the drinking of such water.

To these various hostile criticisms, cogent replies have been produced. Dr. Frankland argues upon the first point that, after the most diligent search, he has failed to discover the slightest evidence of the formation of nitrates from vegetable matters. Whenever nitrates are found in England or abroad, they can be traced generally with the utmost ease, to animal sources, and whenever such sources are absent, nitrates are absent too, although considerable quantities of combined nitrogen may be present. It would be a wonderful thing if the water of the chalk wells did not frequently contain nitrates, considering that it is derived by percolation from the sewage and manure-stained soil above. In the case of the chalk water supplied to London, the probability of direct sewage contamination is peculiarly great, for the great fault in the chalk, from which the Kent Company on one side of the river and the South Essex Company on the other, derives so large a supply of water, passes directly under the foulest part of the Thames. Dr. Frankland admits most fully that the calculation of sewage contamination is only an approximate one. In proportion as the nitrates have been removed by vegetation in streams or reservoirs, the calculation will, of course, be too low. All that he pretends to do is to show the *minimum* contamination which can have occurred, and he points out that injustice cannot be done to the water companies because he can never exaggerate, and very frequently under-states, the previous pollution of their water. It is of course true that animal contaminations of all kinds have to be reckoned in terms of London sewage. The phrase to which Dr. Letheby so much objects is by no means intended to signify that the contamination has in all cases been the actual sewage of towns. All such contaminations are objectionable in the highest degree, and there can surely be no harm in referring them to so suitable a standard as the one selected. It is employed for the comparison of different animal contaminations, just as physiologists compare different kinds of food by their *starch-equivalent*, without intending to assert that all kinds of food consist of starch; and it must not be forgotten that as applied to the greater part of the water supplied to London and other towns, the phrase simply states an indubitable fact.

Finally, we may observe that the self-purifying power of running water is doubted by no one, least of all by Dr. Frankland, who founds his calculation of previous sewage upon his study of it. But the absolute statement made by Dr. Letheby in regard to it—the sharp line which he draws to fix the complete purification of the water —is liable to considerable doubt. Dr. Frankland, Sir Benjamin Brodie, and many other chemists believe the process to be much less uniform and rapid than it has generally been supposed to be, and that, under certain circumstances, it is even almost inoperative; but if their views were entirely erroneous, it would be none the less incumbent upon Dr. Letheby to prove his statement. We know as an absolute fact that tons upon tons

of human excrement are thrown into the waters of the Thames and sea before we drink them, and we have a right to look for absolute demonstration of the complete destruction of all this filth; and not only of the filth itself—of the lifeless organic matter;—we must also be convinced that it is impossible, at all times and under all circumstances, for living matter—the low forms of life and their germs with which the processes of disease and putrefaction appear to be so closely connected—to retain their vitality under the conditions assigned by Dr. Letheby, before we can be content to accept his statement, or can learn to look with indifference upon previous sewage contamination.

It is, we trust, no discourtesy to say that the chemical methods heretofore employed appear inadequate for such a proof. The noxious matters of a water are probably beyond the reach of the test tube and the balance. They belong, in all probability, to that inscrutible class in which the virus of small-pox and cattle plague must be reckoned. That they would resist the oxidising action of the water longer than mere chemical compounds, can hardly be doubted, and, indeed, it has yet to be demonstrated that the dissolved oxygen of the water has any greater destroying effect upon them than it has upon the fishes which inhabit the same streams.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

May 6th, 1869.

Dr. A. W. Williamson, F.R.S., President, in the Chair.

The minutes of the previous meeting were read and confirmed.

The President then read a petition, to be presented to both houses of Parliament, of which the following is a draft:—

"*The Humble Petition of the President and Council of the Chemical Society,*

"Sheweth,—That the Chemical Society was incorporated by Royal Charter for the general advancement of Chemical Science as intimately connected with the prosperity of the manufactures of the United Kingdom. That in the opinion of your petitioners, the future intellectual position of Great Britain, and her success as a manufacturing nation, are in a great measure dependent on the scientific education of her people. That the Society of Arts, in their report on technical education, assert that the only effectual systematic training for technical pursuits consists of two steps—first, a thorough study of several branches of science, including chemistry; secondly, professional pupillage. That at the present time the study of natural science is altogether neglected in a large number of our secondary schools, while in the remainder it occupies only a subordinate position, both in respect of the time allotted to it and of the credit to be gained by proficiency in it. That the neglect of the study of natural science is in great part due to the influence exercised by the endowed schools, which, by their number, their antiquity, and the large funds at their disposal, determine the course of studies in other schools, their own course of education representing the requirements of a past rather than of the present age. That the necessity for inquiry into the teaching in endowed grammar schools has already been recognised by the appointment by Her Majesty of three commissions to report on this class of schools in England and Scotland. That the Schools' Inquiry Commission have, in their report, pointed out various practicable means for the promotion and extension of the study of physical science in schools. Your petitioners, therefore, humbly pray your honourable house to enact such laws as may procure for Chemistry, and other branches of natural science, as important a position among endowed school studies as that now occupied by Latin and Greek.—And your petitioners will, &c."

The following certificates were read:—

For the first time—Wm. G. Valentin, assistant in the Royal College of Chemistry, 126, Lancaster Road, Notting Hill; Thomas Gillham Hewlett, Surgeon, Bombay Army, Health Officer, City of Bombay, Bombay; Captain A. Noble, Engineer, Elswick Ordnance Works, Newcastle; H. Stillington Grey Stephenson, B.A. Oxford, Sympsham Rectory, Weston-super-Mare.

For the third time—E. Meusel, University College; A. W. Reinold, Merton College, Oxford; J. M. Muir, Shortland, Thames Gold Field, New Zealand.

The last-named gentlemen were then balloted for and duly elected.

Mr. J. Lowthian Bell then delivered a lecture "*On the Chemistry of the Blast Furnace,*" of which the following is a condensed abstract:—

There are few chemical processes requiring for their proper operation greater nicety, or where perfect success is contained within narrower limits than the smelting of iron.

The ends sought to be accomplished in the blast furnace are the deoxidation of the peroxide of iron, which is the usual form of combination in which the metal is delivered to the smelter, its carburisation, and fusion; and accompanying this is the expulsion of carbonic acid from the limestone, and the union of the lime it contains with the earthy matters associated with the ore and fuel to form a fusible slag.

The circumstance of the different stages of the operation being effected at different temperatures has led some chemists to divide the interior of the furnace into a certain number of spaces or regions, and designate them according to the character of the action which was supposed to be carried on therein.

Scheerer, among others, assigns a distinct zone to the various steps of the process, namely:—

The Warming Zone.—That is the uppermost part of the furnace, twelve feet downwards from the mouth, in which the ascending current of gases imparts a portion of its heat to the materials just entering the furnace.

The Reducing Zone.—That is the next adjoining seventeen feet of the furnace, where the oxide of iron begins to part with its oxygen, and in which, also, the carbonic acid of the limestone is expelled.

The Carburising Zone adjoined to the former, and compriaing about nine feet of the height of the furnace, where it is supposed that carbon unites with the iron.

The Zone of Fusion,—Supposed to be the next six feet of the furnace, in which the iron is melted, along with the earthy constituents of the materials, by means of the intense heat given off immediately below in the fifth, or *zone of combustion.*

It is into the last zone that the blast is admitted, the oxygen of which is converted into carbonic acid, which gas, coming in contact with incandescent coke, or charcoal, generates carbonic oxide to serve as reducing agent in the upper portion of the furnace.

Scheerer states the degree of temperature of those different zones to be 400° C., 1000—1200°, 1600—1700°, 1800°, and 2000—2650° C. respectively.

Tunner, of Leoben, has, by means of different alloys and various metals, attempted to determine the temperatures of blast furnaces, and he further endeavoured to ascertain by actual exposure of ore at different depths of the furnace the exact point at which reduction began and the rapidity with which it was effected. This he accomplished by placing in a box with the top and bottom provided with apertures, so that a portion of the gaseous contents of the furnace passing through its interior might heat and deoxidise any ore placed therein. This apparatus

was introduced into the furnace, and permitted to descend to different depths along with the usual materials, and was then drawn up by means of a windlass.

Tunner marks a depth of about 20 feet from the throat as the commencement of the process of reduction, which was reached twenty minutes after the ore was introduced into the furnace, and at which the temperature was as high as 700° C.

Ebelmen, by means of apparatus similar to that employed by Tunner, ascertained that reduction commenced at a depth of 8·2 from the top, and after the ore had been two hours in the furnace, and that it was completed at a depth of 18·9 from the throat after an exposure of 6h. 25m.

These investigations have induced them to assume lines of demarcation in blast furnaces (which are represented in sketches adjoined to the paper).

It is, however, doubtful whether any such lines can be laid down in blast furnaces, because to do this would require that each fragment of ironstone is descending with the same speed as all those introduced at the same time, and that every piece is susceptible of being deoxidised as rapidly as the remainder. Neither of these conditions takes place.

Besides, the friction of the materials against the sides of the furnace, particularly when they reach the slopes or boshes, retards considerably the descent of those portions exposed to its influence. The uniform motion of the mass downward is further liable to considerable disturbance by the smaller pieces of ironstone outrunning the larger by slipping through openings in the contents of the furnace, a mode of progress which cannot happen with those of larger dimensions.

Again, the size of the pieces of ironstone exercises a marked influence on the rapidity of the chemical action which the oxide of iron has to undergo during its passage through the upper portion of the furnace. A piece of ore containing a cubic inch of matter, will be perfectly reduced almost before any action has commenced on a second piece of ore, containing a cubic foot, supposing both pieces travelling side by side. In like manner the expulsion of the carbonic acid from the limestone is influenced.

The same delayed action will happen if a considerable quantity of small material is permitted to accumulate in a given portion of the interior of the furnace; indeed, there is perhaps no circumstance which more frequently deranges the operation than this.

The information which is sought to be obtained respecting the temperature of the different sections of a furnace is attended necessarily with considerable difficulty.

Tunner and Ebelmen's mode of judging of the rate of the reduction might be accepted as an indication of what it is under the most favourable circumstances as to size, inasmuch as in his apparatus of limited capacity he only introduced pieces of ore having very small dimensions. The very circumstance, however, of the mineral being incased within a box, introduces an element of difference between the samples under experiment and those in the furnace.

The lecturer's observations would indicate that the oxide of iron, when exposed to the unimpeded action of the gases of a blast furnace, is reduced at a temperature considerably below that assigned by any of the authorities already referred to, and, further, that the rapidity of the process is materially interfered with by any protection like that involved in the use of such a vessel. In order to form some judgment of the temperature and rapidity with which the oxide in the calcined oolitic ironstone of Cleveland was reduced by means of carbonic oxide, a glass tube was filled with pieces about the size of hemp-seed, and heated short of redness. In this state a stream of carbonic oxide was passed over it, and the resulting gas collected and examined. It contained 96 per cent of carbonic acid. A portion of the iron ore so treated was examined, and found to have in the space of 15 minutes lost 39 per cent of its oxygen.

After this a number of specimens of calcined ironstone were exposed at various times to the escaping gases of the furnaces for periods from 1 to 96 hours. Some specimens were placed on an open tray, others in a perforated box, about 6 or 8 feet from the furnaces in the tube for conducting the gas to the boilers, &c. The furnaces employed varied in height from 48 to 80 feet. The temperature of the gases rarely exceeded the lowest of the figures stated by Scheerer, Tunner, and Ebelmen, and frequently considerably below that. Conceding that the gases from the largest furnaces are the coolest, and from the smallest the hottest, the deoxidation is the most vigorous from the small furnaces, and generally speaking, decreases with each addition to its capacity.

The deoxidation of the iron ore to a certain degree increased with the length of time for which the ore was exposed, and amounted, in one instance, even to 100 per cent; the reduction of the ore placed in a perforated box and not on an open tray was sensibly interfered with. (Mr. Bell has adjoined a full list of his experiments to his paper).

In order to investigate whether the proportion of carbonic oxide contained in the gas might possibly affect the rate of the action on the ore, artificial mixtures containing $13CO$, $16CO_2$, $71N$, and $32CO$, $6CO_2$, $21N$, respectively, were separately passed over calcined Cleveland ironstone. Both results proved that almost complete conversion of carbonic oxide in carbonic acid takes place, and that the want of power of deoxidation is not due to a lesser proportion of carbonic oxide.

These and other trials prove that, although mass may retard the action and even delay it until sufficient heat has been imparted, these gases, at a temperature considerably below that stated by the foreign chemists, is sufficient to deoxidise ores of iron.

During the passage of the reduced iron through the furnace, and under the influence of the high temperature to which it is exposed, on its way to the hearth, the metal is apt to carry down some of those substances with which it was originally associated in its ore, or which it meets with in the flux or fuel. To such an extent may this occur that Fresenius quotes a case in which he detects not less than twenty substances other than iron in a specimen he analysed. In some cases as much as 22 per cent of manganese has been found, and above 5 per cent of silicon; but of all those elements mentioned by Fresenius, it is only carbon which may be looked upon as a necessary ingredient of all pig-iron. The circumstances which determine the union of this indispensable element with the metal is one of high interest. The portion of the furnace in which the combination takes place, the temperature necessary for effecting it, and the exact source of immediate supply, have engaged the attention of all chemists who have studied the subject. Scheerer assigned it something like the position before described. Tunner, by means of his perforated box, determined that carburisation did not take place until a depth of 29·8 feet from the top of the furnace was reached, at a temperature of about 1150° C. Ebelmen's idea of the zones of reduction and carburisation is somewhat higher up.

It was next enquired whether it is not highly probable that the box confining the iron ore has not interfered with the action of carburising in the same way as happened, in all probability, with that of deoxidising.

In order to ascertain the extent of change in content of iron, the samples were, after exposure, dissolved in hydrochloric acid, affording, of course, an insoluble residuum.

When a sample of calcined ironstone was exposed for the space of two hours in the waste gas, the residuum was of a greyish colour. The same may be said when the exposure was carried on for three hours with gases produced in the larger furnaces. The smaller furnaces evolve hotter gases—zinc in them frequently melting, and occasionally antimony. The insoluble residuum under consideration, from a specimen after three hours' contact with the hot

gases, was blackish, and this went on increasing as the exposure was prolonged, until it became perfectly black. On the other hand, larger furnaces having above 4½ times the capacity (26,500 cubic feet instead of 6000) never gave off its gases, during a period of observation extending over 96 hours, hot enough to melt zinc; for during 72 hours of this time lead melted, and for the latter 24 hours bismuth only was fused. Ironstone exposed during 96 hours only afforded a greyish insoluble residuum on on being treated with hydrochloric acid.

From these observations it is concluded that an exposure of three hours to a temperature a little above the melting point of lead and below that of zinc sufficed to give the black colour, whereas at about the temperature at which lead fuses, no period up to 96 hours sufficed to produce it.

On examination the blackening was found to consist of carbon. This carbon, moreover, exists in such a minute state of division as to induce the belief that it is really combined with the iron; and it seems highly probable that the carburisation takes place at that comparatively low temperature. Neither does it appear that anything approaching to complete deoxidation is required, for in one case only 6·10 per cent of the oxygen of the ore was driven off, whilst the residuum was blackish, and with anything like 50 per cent of loss of oxygen, the colour is intensely black. On the other hand, oxygen may be removed to the extent, at all events, of 28 per cent, and no strongly-marked signs of carbon appear in the residuum if the heat during exposure has not reached the necessary point of elevation. In the case of the raw ironstone, the colour was much blacker than when the calcined ore was used.

[Owing to the great length of this lecture, we are obliged to defer the conclusion of our abstract, with the discussion, till next week.]

NEWCASTLE CHEMICAL SOCIETY.

A SPECIAL meeting of members of the Newcastle Chemical Society was held, on May 6th, in the theatre of the Newcastle College of Medicine, for the purpose of hearing a paper read by Mr. Ludwig Mond, on "*The Recovery of Sulphur from Alkali Waste.*"

In the absence of the President, whose paper on the "Blast Furnace" was read that evening before the London Chemical Society, Mr. JOHN GLOVER occupied the Chair.

The CHAIRMAN said that, as they were all aware, Mr. Mond was the patentee for the recovery of sulphur from tank waste. Of the importance of that discovery to the chemical trade of this district there could not be two opinions. He trusted that Mr. Mond would enable them, to some extent, to supply a felt want in the chemical trade in this district—namely, the profitable treatment of tank waste.

Mr. MOND, at the outset, said that thousands of pounds had been spent by chemical manufacturers to utilise the waste, or to carry it away, and no one but has had his nose offended and his appetite spoiled by going near waste heaps. In 1860, he commenced, in a chemical manufactory in Germany, a series of experiments on several processes for the recovery of sulphur from waste, and took out a patent in December, 1861. When he came to England (at the time of the Exhibition) he found, to his surprise, that a process, somewhat resembling his own, had been proposed as early as 1836. At the same time as himself, three different parties—in Glasgow, in Newcastle, and in Bristol—had been working in the same direction. His process, however, had clearly the merit of being the first that extracted great quantities of sulphur, and did away with the waste nuisance. He found the process a more expensive one in this country, where labour was dearer than in Germany. He found a difference in the English waste and that which he had been formerly accustomed to. In September of 1863, he took out the new patent. He had previously experimented on tank-waste, and had obtained as much as 55 per cent of sulphur. The first to introduce his process on the Tyne was the Tyne Chemical Company, at South Shields. He believed that the waste of this district was more suitable for using his process than that of Lancashire, as being somewhat more porous. Mr. Mond then explained, by means of a diagram, the working of his process, and exhibited specimens of the sulphur obtained from the waste. He calculated that the cost of extracting the sulphur from the waste would be £1 per ton, but the profit to manufacturers would be about £4 per ton (at Messrs. Hutchinson's, it cost £1 5s. 5d. + 15s. for royalty = £2, working on a comparatively small scale). The cost of the apparatus he calculated to be £1,509, or (providing for all contingencies) £1,660. He thought that the alkali manufacturers ought to be satisfied with the process in a mercantile point of view, and, also, as it enabled them to remove a great nuisance.

The CHAIRMAN said that, whatever might be the opinion of the meeting as to the value of the paper—and that it was of great value no one could doubt—they were under a great obligation to Mr. Mond for the trouble he had taken in bringing so important a subject so very elaborately before them. He had no doubt that some of the gentlemen present would be able to offer comments on the process; he therefore invited any comments on or criticisms of the process, as detailed to them.

In reply to Mr. Archibald Stevenson, South Shields, Mr. MOND said that the waste treated in Holland during four years had been used for a great many purposes. The new station at Utrecht had been built on waste, and a number of the houses had been built upon it. A well, used for domestic purposes, had been sunk through the alkali waste, and the water, though very hard, employed for domestic purposes.

Mr. PATTINSON begged to move a vote of thanks to Mr. Mond for his very valuable paper. It appeared to him that Mr. Mond had solved the problem of disposing of soda waste. When the subject of utilising the waste products was mentioned to him, he had always said that the principal objection was the expense, and it was believed that the substance recovered would not pay the expense of the recovery. Mr. Mond had discovered a process by which they could recover sulphur from waste at a cheap rate; and, therefore, chemical manufacturers ought to be obliged to him for his discovery.

Dr. LUNGE, in seconding the proposition, said that there were two other processes—Schaffner's process and Hofmann's process—both of which involved a very large amount of labour. They involved the removing of the waste from the vat, exposing it to the action of the air for several weeks. He was in Germany last year, and visited a chemical manufactory where Schaffner's process had been introduced. He was told by the manager that they were modifying that process, and bringing it nearer to Mond's process. Schaffner's process had been given up wherever it had been worked, and Mond's process introduced—at least as far as the blowing of air and the decomposition of the liquors were concerned. The only detail of Schaffner's process retained, was the way in which the sulphur was converted into *roll*. As to Hofmann's process, Mr. Bell had mentioned, at the last meeting, that, in his opinion, Mr. Mond's process was a decided improvement on that process.

The CHAIRMAN said that Mr. Mond's process had been alluded to in the report of the commission appointed by Government with regard to the pollution of rivers. It might be that this process could be easily adopted; and, so far as chemistry was concerned, it was easy. But they must remember that there was an increasing manufacture of bleaching powder and of bi-carbonate of soda, and that these manufactures took up the whole of the muriatic acid. The muriatic acid required in Mr. Mond's process would, therefore, be taken up in the manufacture of bleaching powder and bi-carbonate of soda. Thus,

though the process was in itself valuable, seeing that it would, to a considerable extent, interfere with the manufacture of bleaching powder, its adoption for the purpose of reducing the nuisance felt from alkali waste was likely to be very limited.

Mr. MOND acknowledged the vote of thanks accorded to him for his paper, and, in reply to the remarks of the chairman, said that he would like to have an opportunity of going more fully than he would then be able to do into the question of utilising muriatic acid. As he had stated at the end of his paper, about 100,000 tons of strong muriatic acid flowed into the Tyne from alkali works during one year—or acid equal to 100,000 tons of strong muriatic acid. Believing that many manufacturers would be astonished at these figures, he explained how he had arrived at the conclusion. He found that so much salt was decomposed on the Tyne in the year, equal to so much strong acid. Now, the bleach and bi-carbonate made were also known; and, allowing quantities, very liberally calculated, for their preparation, he arrived at this remainder. The quantity of muriatic acid used for bleaching powder was considerably in excess of what was required. He believed that few manufacturers would be unable to find sufficient acid with which to treat their waste.

Mr. SCHOLEFIELD thought that Mr. Mond's figures were erroneous.

Mr. MOND said these were the figures given by Mr. Richard Cail, as Secretary to the Alkali Association, who, if he had been present, might have given them better information on the question than he could supply.

Mr. SCHOLEFIELD said that, if he had received information, he would have provided himself with correct details on the subject.

The CHAIRMAN thought that the figures given by Mr. Cail were likely to be quite correct.

Mr. MOND said that the quantity of acid required to do away with the waste nuisance was from 20 to 25 per cent of the acid. From 1866, the production of bleaching powder had greatly increased, but the production of bi-carbonate had not increased; the amount produced was not at all equal to that in 1866; and it was, therefore, likely that there would be a good deal of muriatic acid to spare.

In reply to a question, Mr. MOND said that the amount of brimstone used in England was 50,000 tons a year, and that the total amount exported from Sicily was 300,000 a year.

In reply to another question, Mr. MOND said he calculated that 40,000 tons of sulphur could be utilised from alkali waste in England in one year.

The meeting then separated.

FRENCH ACADEMY OF SCIENCES.

Monday, May 3rd, 1869.

A CONSIDERABLE portion of the time devoted to the meeting was occupied, as is too often the case with the *savants* who are seated there in the *fauteuils d'honneur*, to personalities.

General MORIN presented a report from the committee appointed to enquire into the alleged insalubrity attending the use of cast-iron stoves. The committee, of which the General was a member, has instituted a series of experiments on this subject at the Conservatoire des Arts et Métiers; the results arrived at are (1) all heating apparatus made of metal, and all stoves made of cast-iron, give off, while in use, a large quantity of carbonic oxide; (2) the quantity of that gas given off from stoves made of plate-iron, more or less thick boiler plate, is often insignificantly small; (3) the carbonic acid contained in the air is readily converted into carbonic oxide, by coming into contact with thoroughly red-hot cast-iron of the stoves made of that material; (4) the oxide of carbon thus generated may, especially in confined localities, become very injurious to health.

The committee recommend to line the cast-iron stoves inside with fire-bricks, and to envelope them outside with a casing of sheet-iron, so arranged as to leave space for free circulation of air in communication with a well-drawing chimney.

On behalf of Messrs. Mille and Durand-Claye, Ingénieurs des Ponts et Chaussées, M. Dumas reports on the work undertaken by these gentlemen, viz., the useful application of the sewage water from Paris, taken at the bridge near Asnières. Every cubic metre of this water contains 1 kilo. of solid matter, and 37 grammes to the kilo. are nitrogenous matter. The engineers above-named treat this water with sulphate of alumina, whereby all the phosphoric acid, two-thirds of the nitrogenous matter, and rather more than one-half of the potassa salts present in the water are completely precipitated, and perfectly clear, inodourous water is left, which may either serve for irrigation of arable soil or meadows, or may be run off into rivers, without injury to the purity of the water of the same.

According to M. Morren, and contrary to the opinion given by M. Sarrasin, hydrogen and nitrogen gases become phosphorescent under the influence of an electric spark or galvanic current, provided the gases be perfectly pure, and under very reduced pressure. This statement gave rise to some discussion, since many of the *savants* present doubted the suitability of the means adopted by M. Morren to insure the purity of the gases at so low a pressure.

M. BERTHELOT read "*A Memoir on the Chemical Equilibrium between Carbon, Hydrogen, and Oxygen*," which we shall, probably, notice more fully at a future day.

Several papers were read about subjects relating to the geology of France, the meteorology and climate of the Isthmus of Suez, which, with some botanical papers, brought this meeting, as far as the public is concerned, to a close, at half-past five o'clock, p.m.

CORRESPONDENCE.

ON A REMARKABLE PASSAGE IN PRIESTLEY'S "LETTERS TO CANTON."

To the Editor of the Chemical News.

SIR,—Being engaged in arranging the Canton Papers, which belong to the Royal Society, I have come to a letter of Dr. Priestley, addressed to his friend, Mr. Canton, and dated "Leeds, 12th November, 1767." After describing some experiments on the melting of brass and steel wires by the electric shock, he concludes his letter in these terms:—

"You will think I talk strangely, but I own that these experiments, together with that of the insulated hot glass mentioned p. 716 of my book, and others too long to recite here, make me inclined to think there is no electric fluid at all, and that electrification is only some new modification of the matter of which any body consisted before that operation."

It is remarkable that Priestley here anticipates the theory which is now generally adopted by electricians. I cannot find, however, that he assumed it permanently, or decisively; on the contrary, he strongly inclined to Franklin's hypothesis of the positive and negative state of all electrified bodies. With a view to ascertain his opinion, I have examined the five editions of his "History of Electricity," and also his "Familiar Introduction to the Study of Electricity." He considers Franklin's theory to be "the most probable of any that have been hitherto proposed to the world" (Hist. of Electricity, part 3, § 2). After a full discussion, he speaks of it in the following terms:—

"Dr. Franklin, the author of this excellent theory of

positive and negative electricity, with a truly philosophical greatness of mind to which few persons have ever attained, always mentions it with the utmost diffidence. 'Every appearance,' says he 'which I have yet seen, in which glass and electricity are concerned, are, I think, explained with ease by this hypothesis. Yet, perhaps, it may not be a true one, and I shall be obliged to him who affords me a better.'"

At the time when Priestley and his friends were employed upon these researches, the celebrated Father Boscovich had attained to the summit of his fame. In the year 1760 he was elected a Fellow of the Royal Society, having visited London and enjoyed the intercourse of some of the most eminent philosophers of this country*. His theory of the constitution of matter, according to which it consists of centres of attraction and repulsion, had become generally known. Both Priestley and his friend and neighbour, Michell, had been interested in it†. We may infer that, in proportion as Priestley regarded with approbation "this sublime theory of the constitution of matter," he must have been inclined to regard electrical phenomena in the same light, which he has clearly propounded in the above-quoted passage.—I am, &c.,

JAMES YATES.

Lauderdale House, Highgate, N.,
May 8th, 1869.

ALKALI WORKS.

To the Editor of the Chemical News.

SIR,—I beg leave to ask the opinion of your readers to the following questions.

(1) Should not alkali works, when they are enrolled under an act of parliament, be exempt from proceedings at law, unless the prosecution is conducted by, and is the result of infringement detected by, the Government Inspector appointed for that purpose?

As a great many cases have, within the last year or two, been brought before the county courts by farmers, and, as the verdict, in the majority of them, has been against the manufacturers, notwithstanding that the Alkali Inspector has appeared as a witness on the opposite side to the farmers, and testified to the complete state of condensation at the time, the following other question suggests itself.

(2). Should not a special scientific legal court be formed for the trial of these cases.

The legal gentlemen connected with county court business laughingly admit their ignorance of chemistry, and at least one judge is exultingly spoken of by farmers as being "dead against chemical manufacturers;" and my impression is that there should be a proper tribunal, and the Inspector, and he only, should be the prosecutor. In Mr. Stevenson, M.P., South Shields (a large manufacturer of chemicals), and Dr. Lyon Playfair, we have good representatives, and I trust they will keep a vigilant look-out.—I am, &c.,

"AN INTERESTED PERSON."

May, 1869.

EQUIVALENCE AND QUANTIVALENCE.

To the Editor of the Chemical News.

SIR,—Mr. Ward, in a communication to the CHEMICAL NEWS, of April 30th, appears to misunderstand the point referred to by Dr. Williamson, since he evidently confounds the terms *equivalent* and *atomic weight*. Your readers will, doubtless, admit the justice of Dr. Williamson's remarks, when they see clearly put before them the theory of equivalence and that of atomicity, or, as Mr. Ward well calls it, of quantivalence.

Let us take the two chlorides of phosphorus, PCl_3 and PCl_5. The theory of equivalence asserts that, in the former, the equivalent weight of phosphorus is $\frac{31}{3}$, that of chlorine being 35·5; while that, in the latter, the equivalent weight of phosphorus is $\frac{31}{5}$; in a word, that the quantivalence of phosphorus is variable. Those who uphold the theory of quantivalence, assert that phosphorus is, under all conditions, trivalent. They maintain that, in compounds resembling phosphoric chloride, the two extra monad atoms (or what is equivalent to them) are combined with the phosphorous compound, in much the same way as that in which one salt combines with another salt to form a double salt. The quantivalence of phosphorus, according to this theory, is invariable.

It would be difficult to find two theories more antagonistic than these. It was, therefore, with great justice that Dr. Williamson complained that many chemists employ the terms equivalent and atomicity indiscriminately; seeing that the former implies a variable, the latter an invariable, quantity.

It is necessary to draw attention to the abuse of the word "fact" in Mr. Ward's letter. He does not distinguish clearly between a *fact*, and a *theory* founded upon facts. The equivalent weight of an element in any particular compound is a fact; its atomic weight and its quantivalence are theories founded upon facts. All chemists agree that, in marsh gas, the equivalent weight of carbon is 3, that of hydrogen being 1; but some ascribe to carbon the atomic weight 6, others 12; and hence we have the different molecular formulæ—

$$\underset{(6)}{C_2H_4} \text{ and } \underset{(12)}{C\ H_4},$$

both representing marsh gas. In the same way, some assert that carbon is divalent; others that it is tetravalent. If the atomic weight and the quantivalence of carbon were facts, what ground would there be for any dispute?—I am, &c.,

TEMPLE A. ORME.

University College School, London,
May 8th, 1869.

A PLEA FOR THE WORD QUANTIVALENCE.

To the Editor of the Chemical News.

SIR,—Most chemists seem disposed to accept the notion of atomicity, but apparently object to the word itself. The ideas conveyed by the terms monatomic (H', &c.), diatomic (O'', &c.), triatomic (N''', &c.), tertratomic (C'''', &c.), more or less modified, are generally agreed to, the names themselves rejected. The cause of this rejection is found, doubtless, in the fact that, instead of conveying to the mind the intended impression of the single, double, triple, and quadruple *value* of atoms in forming molecules, the words monatomic, diatomic, triatomic, and tertratomic give the erroneous impression of *number*; a diatomic body, for instance, is liable to be regarded as containing two atoms, whereas double value alone is intended. In place of these names those of univalent, bivalent, trivalent, quadrivalent, about which there can be no ambiguity, are being adopted by leading chemical authors; but as to which of the words *equivalence* and *quantivalence* shall displace *atomicity* there is difference of opinion. The appellations "equivalence" and "equivalent" are claimed as well known and as covering all the ground commanded by "quantivalence." This they do, undoubtedly, but the objection to them is that they do much more and, from their relative nature, possess any meaning required by the context. The word *equivalent* (with which *equivalence* is indissolubly connected) is not only frequently required and used, and rightly so, by chemical and other authors in several different general senses, but, employed in reference to a chemical atom, it may properly be intended to have distinct meanings. Thus, in regard to the exchangeable

* Fabroni, "Elogi," Tomo ii., p. 41; Rees's "Cyclop.," vol. v. article Boscovich.

† Priestley, "History of Discoveries relating to Vision." "Inquisitions relating to Matter and Spirit," vol. i., p.p. 24-42.

values of atoms of chlorine, oxygen, nitrogen and carbon their respective equivalents are commonly 1, 2, 3, 4, while in displacing 1 part by weight of hydrogen their equivalents will be 35½, 8, 4½, 3, and in forming molecules, 35½, 8, 14, 6, according to old notions, and 35½, 16, 14, 12, according to new ideas. To speak of atomicity (or the subjects of univalence, bivalence, trivalence, and quadrivalence), under the general term *equivalence* is to place unnatural restrictions on the latter word, and divorce the term *equivalent* from proper associations. On the other hand, *quantivalence* is open to none of these objections, and fully satisfies all requirements.

The philology of the matter is indisputable. Let us have either monatomic, diatomic, triatomic, and tetratomic, or univalent, bivalent, trivalent, and quadrivalent; not such hybrids as biatomic or divalent. Pupils of indifferent education also need sometimes to be reminded that the correct pronunciation of the quan-tiv'-a-lence terms is u-niv'-a-lent, biv'-a-lent, triv'-a-lent, quad-riv'-a-lent.—I am, &c.,

JOHN ATTFIELD.

17, Bloomsbury Square.

MISCELLANEOUS.

Statue to Oersted.—We learn from *Cosmos* that a committee has been formed at Copenhagen with the intention of erecting a suitable monument in honour of the great Danish *savant*. A statue, representing the illustrious man, is ordered to be made by a Danish sculptor, named Ferichau, and is intended to be placed in a prominent situation in the capital of the kingdom.

Accident to Professor Bunsen.—The *Carlsruhe Gazette* relates that an accident the other day befel the celebrated chemist Bunsen. He had prepared a quantity of a composition recently discovered, and had dipped his fingers in the vessel, to see if the composition was dry, when that slight pressure sufficed to ignite the whole mass, and a flame arose, which scorched the experimentalist rather severely in the hands and face. He is expected, however, to recover in the course of ten days or a fortnight.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Journal für Praktische Chemie, 1869, No. 2.—This number contains the following original papers:—**Researches on some New Minerals.**—M. R. Hermann, having the opportunity of sorting a parcel of minerals from Niahny-Tagilsk, Russia, found among these one which, in consequence of its outward similarity to copper lazurite, *kupferblau*, attracted his attention. On testing it qualitatively, however, he discovered that, unlike the mineral just named, the substance he had to deal with contained, besides silica, oxide of copper, and water, also a large quantity of phosphoric acid. The mineral was named by him *cyanochalcite*; it is a tough substance, its fracture is even, it is transparent at the edges, has a sky-blue colour, its hardness is 4·5, and its specific gravity 2·79; on being heated, it looses water and becomes black; before the blowpipe it gives the reactions of copper; is readily soluble in hydrochloric acid, does not effervesce with acids, while on becoming dissolved silica is separated in the shape of a powder; molybdate of ammonia added to its solution indicates phosphoric acid. Results of analysis gave, for 100 parts:—Silica, 26·90; phosphoric acid, 6·95; oxide of copper, 49·63; water, 16·52. The genuine copper lazurite contains 45·5 per cent of oxide of copper, but no phosphoric acid at all. Hydrargillite, from Chester county, U.S.:—Hardness, 3·0; specific gravity, 2·35; infusible before the blowpipe. Contains in 100 parts:—Phosphoric acid, 0·91; alumina, 63·84; water, 33·45; silica, 1·50; and traces of magnesia and peroxide of iron. Wavellite, from the same county, contained:—Phosphoric acid, 32·70; alumina, 35·83; water, 28·39; peroxide of iron, 3·08; and a trace of fluorine. The hardness of this mineral was 3·5; its specific gravity 2·30. **On a Constituent of the Resin from the Ferreira spectabilis.**—It appears that in the Brazils there is in use, as a febrifuge, a resin, known in some parts of the country as *sulphato*, in others as *Resina d'angelim pedra*. When this resin is first digested with water, which removes colouring matter, the residue dissolved in water acidulated with hydrochloric acid, and the crystals thereby obtained first purified with water, next with absolute alcohol, again dissolved in hot water, and this solution treated with ammonia, a substance is precipitated which has been named *angelin*; this material had been sent from Cantagallo to Vienna, and was thence forwarded to Prague, to Dr. Gintl, for examination and report. That gentleman, after very exhaustive qualitative and quantitative researches, found, on elementary analysis of the frequently-purified substance, that it consists, in 100 parts, of:—C, 61·51; H, 6·81; N, 7·26; O, 24·42; formula—

$$C_{10}H_{13}NO_3.$$

Dr. Gintl further found that angelin is in all respects identical with Ruge's ratanhin, also in its behaviour with nitric acid, by which both these substances are first made rose, next ruby-red, and finally deep violet coloured, provided only dilute acid be applied, and heated very gradually and gently. **Acetonic Acid.**—This acid is prepared in the following manner:—Aceton, hydrocyanic acid, and dilute hydrochloric acid are mixed, and then left standing together for three weeks; after this time the mixture is boiled on a water-bath for three days in a retort or flask with a condenser attached to it, and so arranged as to admit of the reflux into the retort of the greater part of the condensed liquid; the residue is then treated with ether. After evaporation thereof, a sour yellow extract-like substance is obtained, which contains acetonic, formic, hydrochloric acid, and still a little hydrocyanic acid; this mass is again concentrated by evaporation, then diluted with water, boiled, and while boiling neutralised with carbonate of zinc. After filtration the filtrate yielded acetonate of zinc; this was diffused through water, and the zinc removed by sulphuretted hydrogen, the sulphide of zinc having been separated by filtration, the acid after a time was obtained in solid crystals by slow evaporation. It is a solid, very readily soluble in water, alcohol, and ether; it sublimes when quite dry, and fuses at 79° C. The acetonate of zinc is a difficultly-soluble salt, which contains 24·59 per cent of zinc. **On a Combination of Hydrate of Phenyl and Carbonic Acid.**—M. Barth caused some porous substances to become impregnated with the hydrate of phenyl, and placed these in the iron vessel belonging to Natterer's apparatus for condensing carbonic acid; he then condensed some of that gas in the said vessel, and, on inspection after a few days, he found that the phenyl-alcohol had been converted into a mass of crystals very like those which the cubes of common salt form when agglutinated together. Barth found that these crystals contained carbonic acid, and a series of quantitative experiments proved the quantity of that gas to be from 5 to 5·5 per cent; the crytals fused at 27° C. on expesure to air, and very frequently were forced asunder with a sharp report; when one breathed over these crystals, they became covered with a slight foam. The compound is represented by the formula—

$$8C_6H_6O+CO_2.$$

Bulletin Mensuel de la Société Chimique de Paris, March, 1869.—This number contains the following original articles:—**Researches on the Milky Juice of the Antiaris toxicaria.**—Dr. De Vry and M. E. Ludwig have made researches on this substance, the produce of a tree which grows wild in Java, the juice of which, here alluded to, is applied by the natives to poison arrows; the specific gravity of the juice is 1·06; on evaporation it leaves 37·9 per cent of a brown resin. This resin, treated with warm petroleum (boiling at 60°) and with absolute alcohol, leaves 47 per cent of substances insoluble in these fluids; the petroleum dissolves an amorphous, and also a crystallisable resin, some fatty matters, and caoutchouc. The alcoholic extract contains antiarine, an acid, and a saccharine substance, while the insoluble portion is albumen. The antiarine is a glucoside, which can be split up into sugar and a yellow resin; its composition in 100 parts is expressed by—C, 61·2; H, 8·1; O, 30·7. The crystallisable resin, differing from the resin antiar described now about forty years ago by Mulder, contains in 100 parts—C, 83·9; H, 11·9; O, 4·2. **On the Colouring Matters of the Anthracen Series.**—MM. Graebe and Liebermann have found that when purpurine (extracted from madder root) is heated with powdered zinc, anthracen is obtained identical to that which alizarine yields when distilled with zinc. When purpurine is treated with reducing substances it yields, as also does alizarine, a colourless substance, which oxidises in the air, and then yields again purpurine. From these and other reactions the authors infer that purpurine is oxyalizarine, or trioxyanthraquinone—

$$C_{14}H_5\left\{\begin{matrix}(HO)_3\\O_2''\end{matrix}\right.$$

Chrysophanic acid has been considered by Rochleder as represented by—

$$C_{10}H_8O_3,$$

while Gerhardt expressed its constitution by—

$$C_{14}H_{10}O_4;$$

this acid yields, with nitric acid, chrysammic acid, which, according to the authors of this paper is tetranitroxyanthraquinone—

$$C_{14}H_2(NO_2)\left\{\begin{matrix}H_2O\\O_2''\end{matrix}\right.$$

Aloine, treated by powdered zinc, has also yielded anthracen; aloine yields chrysammic acid when treated with nitric acid. Gentianic acid—

$$C_{14}H_{10}O_5,$$

and euxanthone—

$$C_{20}H_{12}O_6,$$

have been likewise treated by zinc; these acids did not yield anthracen, but other hydrocarbons. **Iron in Milk.**—M. Bistron has found that the milk of the female goat contains on an average 0·1 grm. of iron in 1,000 parts of milk; this quantity of the metal appears to be constantly present in that fluid, and corresponds with the quantity

found in the milk of women. **On the Application of Alkaline Iodides as Reducing Agents.**—M. Berthelot read a short paper on this subject at the meeting of the Paris Chemical Society, relating his experience in this respect, and stating that though iodide of potassium is in many instances more preferable to use than hydroiodic acid, it is less active than that substance. The same applies to iodide of ammonium; this is explained by the author to be caused by the greater stability possessed by these compounds. **On the Use of Protoxide of Thallium as an Ozonoscopic Substance.**—M. Lamy communicated, at the meeting of the Society, the following observations made by him concerning this subject as the result of a series of experiments made during a year, not only in Paris, but in divers parts of France, including some remote mountainous districts:—(1) Protoxide of thallium assumes a brownish tinge, even when out of reach of any air or ozonised oxygen; (2) the sensitiveness of the thallium paper varies according to the degree of concentration of the solutions which have been applied in preparing it, or their more or less advanced state of carbonatation; (3) recently-prepared thallium paper is more sensitive to ozone than paper prepared with starch and iodides; (4) the more or less dark colour of the thallium paper only, then, indicates ozone when that same paper afterwards renders tincture of guaiac blue when moistened with that fluid; (5) when this condition is properly attended to, protoxide of thallium paper is very fit to indicate rapidly and with certainty ozone, even in an atmosphere containing nitrous acid fumes; but this paper can only serve as a reagent for ozone, and is not fit for showing any quantity thereof in the atmosphere. **On the Action of Light upon Sulphide of Carbon.**—Many of our readers have had the opportunity of noticing that the bottles, especially if made of white glass, containing sulphide of carbon often become lined, if exposed for any length of time to direct sunlight, with a coating strongly adhering to the glass. M. Loew has experimented on this substance, by enclosing the sulphide in sealed glass tubes previously moistened with water, which has the effect of lessening the adhesiveness of the brownish coating. On opening the sealed tubes after a few months' exposure to sunlight, the water was observed to have an acid reaction, due to the formation of some formic acid; the solid substance alluded to is insoluble in alcohol, chloroform, ether, and sulphide of carbon, but soluble in a boiling solution of caustic potassa, becoming, however, at the same time decomposed. The substance is sesquisulphide of carbon, which, on being submitted to distillation, is decomposed, yielding sulphur and carbon; the sulphide of carbon from which this substance is deposited contains sulphur in solution, though perfectly pure previous to exposure to sunlight. **Estimation of Suboxide of Copper occurring in Metallic Copper, and especially in the Variety of this Metal known as Rosette.**—When dilute sulphuric acid acts upon suboxide of copper in the presence of nitrate of silver, the suboxide is split up into metallic copper and oxide of copper, which becomes dissolved as sulphate, while the metallic copper takes the place of the silver of the nitrate of that metal. In order to apply this reaction for analytical purposes, M. C. Aubel takes 0·5 gramme of the copper to be tested, previously reduced, by proper mechanical means, to powder or filings; he adds 1·5 grm. of solid nitrate of silver mixed in a mortar with 10 c.c. of dilute sulphuric acid. The decomposition sets in at once, and is entirely complete after two hours' time; water is then added, the metallic silver is collected on a filter, well washed, and, after having been dried, is weighed. **Volumetrical Estimation of Chromic Acid.**—M. C. Zulkowsky adds to the chromic acid solution a sufficient quantity of iodide of potassium, free from iodate, and pure hydrochloric acid. This mixture is left quietly standing for from half an hour to a few hours' time, according to the degree of concentration of the solution, for in no case is the reduction of the chromic acid by means of the hydriodic acid instantaneously effected. When the reduction is complete, which may be learned from the pure green colour the liquid has assumed, a small quantity of thin starch paste is added, and the quantity of iodine which has been set at liberty is estimated by titration with a solution of hyposulphite of soda. Quantitative test solutions are prepared by dissolving 24·8 grms. of hyposulphite of soda in a litre of water, and 4·9196 grms. of bichromate of potassa also in a litre of water; by this arrangement 1 c.c. of the first solution is equal to 1 c.c. of the chromate solution containing exactly 0·003349 grm. of chromic acid. **Testing Sulphate of Quinine.**—M. Panot applies, for the purpose of ascertaining the presence of salicine in sulphate of quinine, the well-known action of oxidising substances upon salicine, and the transformation of the hydride of salicyl into a substance which, under the influence of perchloride of iron assumes a bluish violet colour. The suspected sulphate of quinine is placed in a flask, to which, by means of a perforated cork, a glass tube can be fixed; then 2 c.c. of dilute sulphuric acid (1 of acid upon 4 of water), and 4 c.c. of a saturated solution of bichromate of potassa, are poured into the flask; heat is applied to the flask, and its contents brought to boiling, while the products of the distillation carried of by the glass tube are collected in distilled water. When the reaction ceases, some few drops of a solution of chloride of iron are added to this distilled water, and, should a violet colouration ensue, this will be evidence of the adulteration with salicine of the sulphate of quinine; the presence even of ½ per cent of salicine is very readily proved by this process.

On the Characteristic Differences and Tests for the Detection of some Fatty Oils.—Dr. Sacc, of Neufchâtel.—(*Rev. Hebd. d. Chim.*, No. 22, 1869.)—Although the fatty oils are nearly all compounds of fatty acids and glycerine, there exists among them so much difference of physical properties that there is good cause to assume that the diversity of taste and the colour and odour exhibited by these oils is due to very slight differences in chemical characters, and hence behaviour with reagents, which the author has endeavoured to find out, and thereby render the detection of adulteration a more easy matter. *Olive oil.*—Colour light yellow, odour faint; heated to nearly its boiling point it decrepitates, in consequence of having retained slight traces of water, and becomes discoloured without further change. A mixture of equal bulks of oil and of nitric acid of 1·31 sp. gr. at 55° F. does not at the ordinary temperature produce any change. Sulphuric acid of 1·76 sp. gr., and at 55° F., unites with the oil, the mixture becomes hot, dark coloured, and, on addition of cold water, the dark mass, while dissolving therein, becomes white. Commercial acetic acid has no action whatever upon the oil; caustic soda lye of 1·04 sp. gr., at 55°, produces, even in the cold, a white emulsion; alcohol of 90 per cent floats on the oil, but does not dissolve it. Ether, benzol, light petroleum, naphtha, sulphide of carbon, and spirits of turpentine dissolve the olive oil and all the following oils. A solution of nut-galls, of 100 grammes weight of galls to the litre of water, does not change olive oil when mixed therewith; this reaction enables us to distinguish between ground-nut and sesame oil, with both of which olive oil might be confused. Caustic ammonia readily forms a beautifully-white emulsion with this oil, which is not at all acted upon by solutions of nitrate of silver and chloride of gold. *Colza Oil.*—Golden yellow colour, faint odour, somewhat resembling that of turnips; when heated to boiling point its colour becomes lighter. Nitric and acetic acids do not act upon this oil; sulphuric acid, when mixed with this oil, evolves much heat, while a dark brownish mass is formed, which, on being dissolved in water, becomes white; caustic soda solution and liquid ammonia form emulsions with colza oil, which is insoluble in strong alcohol and specifically heavier than that fluid. Solution of nut-galls forms an emulsion, and the same is also the case with chloride of gold and the oil; nitrate of silver causes a turbidity in the oil, and appears to become partly reduced to metal. *Oil from Arachis hypogœa: Ground nut oil.*—Light straw-yellow colour; odour faint; no change when heated to boiling point, and becomes turbid and more dark yellow coloured on addition of nitric acid; addition of sulphuric acid evolves much heat and changes it, as did the same acid when added to colza oil; with soda solution and with solution of nut-galls the same behaviour as the foregoing, ammonia also as the foregoing, and alcohol the same; no action with nitrate of silver, while chloride of gold forms an emulsion with this oil, and becomes partly reduced to the metallic state, perceptible by a violet colouration. *Nut oil.*—Bright lemon yellow; odour acrid; heated, it boils quietly, and its colour becomes less deep; is rose-coloured by nitric acid, but the colour disappears very rapidly, and a slight turbidity is produced; with sulphuric acid a great heat is developed, and the oil obtains a cinnamon-brown colour; the mixture swells upon being placed in water, becomes white, and a portion of oil which had not been apparently acted upon floats on the top of the water. Acetic acid, soda solution, and solution of nut-galls do not act upon this oil at all; alcohol does not dissolve it and floats on it; nitrate of silver causes a slight turbidity, while chloride of gold is readily reduced by the oil. *Whale oil.*—Dark yellow coloured; odour very disagreeable and nauseous; on being heated, the oil boils readily and without spurting; nitric acid produces a bister colouration; sulphuric acid developes very little heat, and causes a cinnamon-brown colouration. When the mixture of this acid and oil are placed in water it becomes white and disengages an odour somewhat resembling that of asphalt. Acetic acid and solution of nut-galls are without action upon this oil; with soda solution a yellow emulsion is formed; alcohol does not dissolve it; liquid ammonia forms a yellow emulsion; nitrate of silver, no action; chloride of gold, traces of duction. All the reactions before-mentioned have been made with equal bulks of oils and reagents in test-tubes at a temperature of from 15° to 20° C., and the substances have been left in contact for thirty-four hours; this also applies to the following experiments:—*Cotton-seed oil* (of course refined).—Bright orange yellow colour, faint odour, no change on being boiled; becomes brown at the points of contact when treated with nitric acid. Sulphuric acid causes evolution of much heat, changes it into a brown mass, which, on being placed in water, becomes white and dissolves therein; acetic acid and nitrate of silver have no action upon this oil; solution of soda and liquid ammonia form emulsions with difficulty with the oil, which is itself insoluble in alcohol; solution of nut-galls causes an emulsion, as does also a solution of chloride of gold, which is, moreover, perceptibly reduced to the metallic state. *Sesame-seed oil.*—Colour bright yellow; odour faint; becomes nearly colourless when heated to boiling point. With nitric acid, bright orange colour; with sulphuric acid, evolution of heat, dark brown colour, and, on addition of water, violet colour, and soluble therein (it should be observed that sulphuric acid really saponifies most of these oils, and that the soap so formed is soluble in water added in excess); acetic acid, no action; with soda, ammonia, and nut-gall solutions, emulsions are formed, all of which exhibit a white colour; not soluble in alcohol, and thickens on addition of nitrate of silver. Chloride of gold causes formation of an emulsion, and is itself perceptibly reduced to the metallic state.

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

982. **J. C. Lee, Ashton-on-Mersey, Cheshire, "Certain methods of collecting excreta, and of treating the same in order to render them comparatively innocuous, and to obtain a useful product or useful products therefrom."**—Petition recorded April 1, 1869.

1256. **H. E. Newton, Chancery Lane, "Improvements in puddling iron."**—A communication from C. Hewitt, Trenton, New Jersey, U.S.A.—April 23, 1869.

1278. T. Forster and P. B. Cow, jun., Streatham, "Improvements in compounds containing India-rubber, gutta-percha, or balata, and in the manufacture of such compounds.—April 24, 1869.

1317. A. Meredith, Newgate Street, London, "Improvements in the manufacture of iron and steel."—April 28, 1869.

NOTICES TO PROCEED.

3930. W. H. Walenn, Tufnell Park, West Holloway, Middlesex, "Improvements in the electric deposition of copper and brass."—Petition recorded December 24, 1868.

3967. S. F. Henley, Pimlico, Middlesex, "Improved means of operating upon stick or gum lac, for the extraction of colouring matter or lac dye, and for the production of shell-lac.—December 30, 1868.

4. W. M. Williams, Sheffield, "Improvements in fettling or lining puddling furnaces used in the manufacture of iron and steel."—January 1, 1869.

164. A. M. Clark, Chancery Lane, "Improvements in the manufacture and refining of sugar.—A communication from L. J. F. Marguerritte, Boulevart St. Martin, Paris.—January 18, 1869.

1178. G. T. Bousfield, Brixton, Surrey, "Improvements in the manufacture of heavy hydrocarbon oils, and in apparatus used therein.—A communication from J. Merrill, Boston, Mass., U.S.A.—April 16, 1869.

NOTES AND QUERIES.

On the Cause of a Pink Colour in White Lead Corrosions.—It appears, from the experiments of Mr. W. Baker (*Phil. Mag.*, May, 1869), that not, as be formerly supposed, oxide of copper, but metallic silver, when present in lead in small quantity, is the cause of the pink colour now and then observed by white lead manufacturers. Analysis of 5,000 grs. of white corrosion gave:—CuO, 0·0050; FeO, 0·0022; NiO, trace; Ag, 0·005, per cent. Pink corrosion:—CuO, 0·0060; FeO, 0·0022; NiO, 0·0013; Ag, 0·0958 per cent. A decided colour, which is uniform throughout the mass of the corrosion, is obtained when the silver amounts to about 1½ ozs. per ton. The author ascertained that the silver is present in metallic, but of course finely-divided, state.

Discovery of Natural Gas.—Some workmen, while boring for water at Middleton Hall, Uphall, Linlithgowshire, observed that gas escaped from the bore-hole. They applied a light, and instantly the gas blazed up in a beautiful white light, and continued to burn with increasing force, until it was extinguished by the workmen in order to resume their boring operations. The stratum from which the gas evolves is well known to mineralogists as the marl which overlies the rich bituminous shales of this district. Judging from the extent of the source of supply, and the richness of the gas, it might be profitably employed for heating and illuminating purposes, and the shale worked for oil making. The parish of Uphall is contiguous to Bathgate, well known for the Boghead coal being found in its neighbourhood.

Mutual Decomposition.—In the employment of common reagents in an aqueous analysis, it is usual for the test employed and the substance sought, if present, to mutually decompose each other, and to form salts of a different nature—for example, the determination of sulphuric acid in a soluble sulphate by means of a soluble salt of barium; the acids in this case are transposed, because of the stronger affinity of the acid of the first base for the base of the second. But in the dry way it frequently happens that, at an elevated temperature, acids and bases lose the stronger affinity, and combine with other bases and acids, for which at ordinary temperatures they have a lesser affinity—for example, sulphate of baryta and carbonated alkali. Now, in the case of a mixture of sulphate of lime and carbonate of magnesia, I had no standard chemical work for reference to ascertain whether, on application of heat, these salts undergo decomposition—carbonate of lime and sulphate of magnesia resulting, or more probably caustic lime and sulphate of magnesia, as such was my impression; hence my note appearing in your issue of the 23rd ult. I am obliged for your answer of last week, but thinking so an apparently simple matter—as to whether these salts do or do not decompose at a high temperature, say a red heat—must be well known to those skilled in chemistry, is my excuse for again writing.—W.

Purifying Water.—(*Report of the Netherlands Committee.*)—It is a well-known and generally-observed fact that the water of rivers, canals, and some lakes is never quite clear. This turbidity, which often remains even after many days of quiet rest, is partly due to inorganic substances floating about in the water and suspended therein, but is far more frequently caused by matters of an organic nature too minutely divided and too small to be readily recognised, even by a powerful microscope. The researches of some of the members of this report have undeniably proved that, at least as far as the Netherland waters they submitted to research are concerned, this turbidity is due to extremely minutely-divided clay, by the aid of which a great deal more of organic matter than could otherwise remain suspended is kept in such an extreme state of division as to pass through filters and not deposit, even after many days of rest. When, to such kinds of water, a solution of alum (from 1-50,000th to 1-100,000th of the bulk of the water) is added, it will be observed that after a longer or shorter lapse of time a flocculent precipitate is formed, which is either alumina or a basic sulphate thereof, which flocculent material takes up all the turbidity of the water, leaving that perfectly clear; the precipitate thus formed has been submitted to chemical tests, and it was found to contain a large quantity of organic matter, and to yield, on being heated with soda-lime, ammonia very largely. Since the committee was instructed to ascertain and discover the means of improving the condition of the potable waters where it was required, this especially also applied to the towns and villages whose chief supply of water for domestic and drinking purposes depends upon that of the river Maas, along the banks of which, in the lower portion of its seaward course, the population is entirely dependent upon its water; which has been almost from time immemorial known to produce, in those not accustomed to its daily use, a diarrhœa, which in certain individuals is accompanied by very unpleasant, if not always, therefore, dangerous symptoms. The water of this river has been analysed over and over again by many eminent scientific chemists, and has been submitted to microscopic research, but no trouble, nor anything science could, armed with its best weapons, bring to bear on this research, has ever revealed the precise cause of this peculiar property, which is not possessed by the water of the same river, nor also by that of the Rhine, higher up its course. For curiosity's sake, we here quote the result of one of the most recent analyses of this water taken at flood tide at Rotterdam:—Physical properties—very turbid, does not become clear on standing, is not rendered clear on addition of a few drops of hydrochloric acid; taste—not quite unpalatable; solid residue—dried at 120° C., yielded, for 1 litre, 0·195 grm., containing 0·055 of combustible matter; earthy salts—0·0975 grm., containing 0·048 sulphate of lime, chlorides of alkalies, 0·0233; ammonia—none; slight trace of nitrates; dry residue had a yellow colour before ignition. It is a highly-important fact, and one of very general importance to learn, that Dr. J. W. Gunning, of Amsterdam, has found that the perchloride of iron added to this water (and the same applies to far more foul waters experimented upon) has the effect of rendering it perfectly wholesome and even agreeable for use. To one litre of water, 0·032 grm. of the dry salt just alluded to, and previously dissolved in pure water, are added, and, after well stirring the liquid, it is left quietly standing, to settle, for fully thirty-six hours. A series of very carefully-made experiments has proved that no free hydrochloric acid (the quantity thereof contained in the above-stated weight of perchloride of iron only amounts to 0·021 grm.) was left in the clarified and purified water, but in order to suit the application on the large scale, and to make assurance doubly sure, as regards any acid or perchloride being left undecomposed, or rather uncombined, with the organic and inorganic matter of the water, Dr. Gunning has advised that a small, but equivalent, quantity of crystallised carbonate of soda should be also added some hours previous to beginning to take the purified water for use. At Dr. Gunning's request, a scientific gentleman of high attainments, who happens to have an excellent opportunity, near Rotterdam, to try on the large scale this process, has submitted it to practical test, and a quantity of no less than about 240,000 litres of Maas water, taken at all times of the year, has been treated by this process, and thereby rendered perfectly fit for use, and consumed by various parties, has proved to have been entirely deprived of its property of causing diarrhœa; moreover, the medical officer in charge of the crew of Her Majesty's corvette the Lynx, moored off Rotterdam, in the river, has applied this process to the water taken from the river, and found by experience that the thus purified water has even the good effect of restoring to health such of the crew as had been incautiously drinking the not previously purified Maas water. It is, when using this means of purifying bad water, of great importance to let the sediment quietly settle; it occupies about 4-10ths of the bulk of the water, which on the large scale will, for security's sake, be submitted to a filtration through fine well-cleansed sea-sand before being sent through the mains of the large waterworks intended to be established near Rotterdam for the supply of that town. The quantity of crystallised carbonate of soda which is equivalent to 0·032 grm. of dry perchloride of iron is 0·085 grm.; both these quantities are the maximum required to render the Maas water perfectly pure, even at the time when it is most turbid; comparative experiments have conclusively proved that the application of this process is very superior to filtration of the water, even through animal charcoal. The result obtained with the Maas water having been so eminently successful, the committee has applied this method to the purifying of water otherwise non-drinkable, such as is met with in many of the smaller canals, brooks, and also pumps yielding surface water of bad quality in many parts of the kingdom, and the results obtained are such as to justify the order that this method of purifying must be applied by authority to a class of waters which, thus treated, become available for use. The precipitate formed by the addition of the perchloride of iron and carbonate of soda, both previously dissolved, has been proved, by accurate analysis, to contain a large quantity of organic matter, which, on being ignited with soda-lime, yielded ammonia very largely; analysis has also proved that, as regards the Maas water, the only addition to its inorganic constituents is that of one part of chloride of sodium, by weight, in 40,000 parts of water by the application of this process. Dr. Gunning has found that the effect of the perchloride is not so conspicuous with some well waters containing much carbonic acid; while, moreover, there may exist in some of these kinds of waters, either in quantity or quality, inorganic salts which delay or altogether impede the peculiar mode of flocculent precipitation observed with the above-named Maas and other waters to take place after addition of the iron salt.

MEETINGS FOR THE WEEK.

TUESDAY, 18th.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."

WEDNESDAY, 19th.—Society of Arts, 8.

—— Pharmaceutical (Anniversary), 11.

THURSDAY, 20th.—Royal Institution, 3. Professor Tyndall, "On Light."

—— London Institution, 6.

—— Zoological, 4.

—— Chemical, 8.

FRIDAY, 21st.—Royal Institution, 8. Professor Jenkin, "Submersion and Recovery of Submarine Cables."

SATURDAY, 15th.—Royal Institution, 3. Prof. Seeley, "On Roman History."

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THE CHEMICAL NEWS.

VOL. XIX. No. 494.

ALKALI WORKS.

We inserted last week a letter from an alkali manufacturer urging that if alkali makers comply with the "Alkali Act," no farmers or other persons ought to be allowed to complain. This is a bold position. He forgets that the Alkali Act controls one gas only. We suppose he is an Englishman, and yet he wishes to take from his countrymen the right of grumbling—the right of petition and complaint. We doubt if Parliament, with all its power in this respect, can interfere. Besides, the Alkali Act does not demand perfection from the manufacturers. It was established to diminish an evil in such a manner that it should not hurt the manufacturers; but it did not attempt to decide whether the 5 per cent of muriatic acid allowed to escape could under any circumstances injure any person. We know that coal smoke will damage plants, because of the sulphurous acid in it, small as it is; we conclude, therefore, with certainty, that any addition of acid will injure them yet more; and 5 per cent of escape from an alkali works may probably injure in cases where the total amount given out is great and the fields readily struck.

Admitting that an alkali maker is very far from infringing the Alkali Act, is he always equally innocent of doing mischief by gases not mentioned in it? Weight for weight sulphuric acid is in reality more dangerous to plants than muriatic acid. It is extremely heavy, and a little does much evil, because it does not readily disperse. Now, do the alkali makers and sulphuric acid makers keep all their fumes to themselves? We have no information as to the alkali makers, but we have heard of a man, not an alkali maker, who lets go 20 per cent of his sulphuric acid. We enquire of the Inspector of Alkali Works, and what does he say?—He is very sorry, but he has no right to interfere, or even to enter the works. If he were asked his opinion of such a work—supposing it were also an alkali work—he would say that, so far as he is concerned, he can find no official fault; and this would be a work complying with the Alkali Act, and yet worse than farmers even imagine.

Some people may think we are talking loosely, and that, as it is the interest of a manufacturer to keep his acid, they may venture to assert such prodigality is impossible. This kind of argument is very common; so far as chemical works are concerned, however, it does not hold good: people do act against their own interests. Do we not know in the abstract that all evil is against the true interest of man, but it does not therefore cease?

We hope we have said enough to show that the Alkali Act is not sufficient to protect the farmers even from alkali works; and what shall we say of copper works, sending out their 100 per cent of sulphurous and sulphuric acid in clouds that dull the sky for miles; of chlorine, of nitrous gases, of sulphuretted hydrogen, and of fluorine compounds? The Alkali Act regards only one of the noxious gases; and the question may be put—Shall it be extended to more? In some places its influence can be but small, because so many other gases interfere. But, even when they do not interfere, is it not true that an escape of muriatic acid may come, and, in a few hours, destroy the labour of months? Is this just in the alkali makers? Of course, all are not to be blamed for this, nor are all believed to allow any sulphuric acid to escape, but we say it because, as a rule, the farmer has ground for complaint as well as the alkali maker. We do not, however, entirely take the farmer's side; by no means; we know of men who could not stay at a farm when the alkali works were given up; and the greediness of human nature constrains us to doubt if the manufacturers are quite justly treated by the farmers.

"An Interested Person" asks if a scientific legal court ought not to be constituted. Trials for nuisances are generally very unsatisfactory. There is no authorised person to put down the daring assertions made by some men. We have heard one say that sulphuretted hydrogen did no harm to human beings, and the judge could not contradict. Not long ago we heard of a witness who said that the gases complained of were a mixture of sulphurous acid, chlorine, and sulphuretted hydrogen! Now, no judges are even expected to know that these gases cannot exist together, and, with one or two exceptions, barristers do not know. If a chemist happen to be present, he may get a pertinent question put, but if not very determined, he may find a difficulty, and many would rather let the case go to wreck than be put to the discomfort of asserting their knowledge amidst the unpleasant badgering of a public court. The greater number of the questions arising at a trial would be settled by men who had very simple notions of justice if only the facts were well known.

Would a scientific court do the work better? It was purposed that the Inspector should have most of the gases under his view, and should be allowed to settle questions which involved claims such as are brought to a County Court. We do not pretend to decide, and should be unwilling to lay claim in favour of scientific men to the prejudice of such an important body as men of law. We believe that it would be better for both parties if the facts of the case were probed more fully by a chemical mind. Scientific men cannot expect to adjudicate so clearly in vexed questions as the legal profession, which has struggled since civilisation began to put in order the varied activities of the human race, which yearly invents new crimes and makes room for new virtues. Perhaps "An Interested Person" may, on further consideration, think his view of this question not quite adequate.

ON SOME APPLICATIONS OF ELECTRICITY TO NAVAL AND MILITARY PURPOSES.*

By F. A. ABEL, F.R.S., For. Sec. C.S.

(Continued from p. 221).

A CLASS of electrical instruments has been created within the last three years which bids fair to supplant even these very powerful and efficient frictional machines. The instruments in question, of which different forms have been devised by Wheatstone, Wilde, Siemens, and Ladd, have received the generic name of *dynamo-electric machines*, because dynamic force becomes through their agency a direct and powerful source of electricity. In the machines of Siemens, Wheatstone, and Ladd, mechanical power is transformed into electric force without the intervention of permanent magnets. The action of the most simple form of these instruments may be described as follows:—The residual magnetism existing in an electro-magnet suffices to develop an induced current in a rapidly-revolving coil armature; this current, reacting upon the electro-magnet, determines the development of powerful magnetism in the latter by the inductive action of its insulated coils; the currents developed by the electro-magnet are consequently in their turn greatly increased in power, and react again upon the armature; and thus an immense accumulation of electric force is accomplished with great rapidity until, when that accumulation has reached the maximum attainable without detriment to

* A lecture delivered before the Royal Institution of Great Britain, March 12, 1869.

the insulation of the wire coils, a simple interrupting arrangement causes the current to be diverted from the machine to conducting wires, by whose medium it is utilised. The details of the machines vary according to the different plans adopted by the several constructors, but the above explanation applies more particularly to the machines of Messrs. Siemens and Halske, who have been the first to produce a small instrument of this class thoroughly applicable to mining purposes, and which almost equals in power the ebonite frictional electric machine. Fifty charges, arranged in simple circuit, have been repeatedly exploded, without any failures, by one of these machines; it therefore provides with certainty the power necessary for the most extensive mining or submarine operations, and is at the same time quite free from all disturbing atmospheric influences. Its mechanism is simple, and less easily susceptible o derangement than that of any magneto-electric apparatus, and as it is independent of everything but the application of manual power for the development of its action, it is far superior to the most perfect of these, independently of the fact that it surpasses them all greatly in power. For many important military and mining operations the hand-dynamo-electric machines, constructed by Messrs. Siemens and Halske, are therefore unquestionably superior to all other existing apparatus which furnish electricity of tension. This class of instrument, however, shares, to some extent at any rate, one important defect of the frictional-electric machines, which is consequent upon the powerful charges of high-tension electricity sent into conducting wires by their agency. It was observed, in the earlier experiments of the Austrians with frictional electricity, that if two or more insulated wires which led to distinct mines were situated side by side, in moderately close proximity, even only for comparatively short distances, the charge sent from the machine into one of the wires, with the view of only exploding a particular mine or series, might develop in neighbouring wires, not connected with the machine, a charge of induced electricity of sufficient power to explode the mines connected with those wires. Some results obtained at Chatham, and many experiments recently instituted at Woolwich, have not only confirmed those observations in Austria, but have shown that means do not at present exist of avoiding this serious defect of powerful charges of high tension. If, therefore, it is necessary to lead separate wires from the point of operation (from the exploding instrument) to different mines or groups which it is desired to explode independently of each other, it is impossible to employ the frictional electric machine as the exploding agent without great risk of failure, even though the wires, laid upon or imbedded in earth, are separated as widely as possible, as they must unavoidably extend in proximity to each other to a distance from their points of union with the machine, which, if the latter be highly charged, may prove sufficient to determine the development of induced "exploding" currents in the wires leading to mines not intended to be fired. If the wires lead to submarine mines or torpedoes, and are therefore submerged, the unintentional explosion of mines becomes much more certain, and the frictional machine is consequently inapplicable to submarine operations in all instances where mines are arranged in separate circuits. The dynamo-electric machines share this serious defect to some extent; still, with proper experience in their use, they are not altogether inapplicable to such services as above specified. If Siemens's dynamo-electric machine be highly charged by very rapid revolutions of the armature, the inductive action of the charge will be similar in power to that exerted by the charge of the frictional machine, but, by revolving the armatures slowly, it is possible to charge the machine sufficiently to fire a mine or a small group with certainty, while the inductive action of the charge sent into the wire will not influence neighbouring wires to an extent sufficient to cause the explosion of mines connected with them.

The subject of the application of electricity to the explosion of submarine mines for purposes of defence and attack received some attention from the Russians during the Crimean war, and was practically developed in its most simple form in 1859, in the hands of the Austrian government, when a system of submarine mines, to be fired through the agency of electricity by operators on shore, was applied by Baron von Ebner to the defence of Venice, which, however, never came into practical operation. The subject of the utilisation of electricity for purposes of defence did not, however, receive serious consideration in England or other countries until some years afterwards, when the great importance of submarine mines as engines of war was demonstrated by the number of ships destroyed and injured during the war in America. Twenty-five vessels belonging to the Federal navy were destroyed and nine others injured by the explosion of torpedoes, while the Confederates lost three vessels by accidentally coming into collision with their own torpedoes, and one which was attacked by means of a torpedo and destroyed by the Federals.

Soon after the commencement of that war the attention of the English government was called to the importance of practical inquiry into the value of submarine obstructions, both passive and active, as auxiliary agents of defence, and a committee was appointed at the suggestion of Colonel Jervois, C.B., R.E., to report on the use which might be made of floating or sunken obstructions and of submarine mines, in the defence of channels, harbours, and rivers. The labours of this committee have recently terminated, and they were enabled, by the aid of systematic investigations conducted for them at Woolwich during the last four years by one of their members, Mr. Abel, and of practical experiments carried on chiefly at Chatham under the direction of another of their body, Colonel A. à'C. Fisher, C.B., R.E., to elaborate the subject of the application of electricity to submarine mines and torpedoes, to such an extent that a solid foundation of information and instruction is now available for those who may at any time have to be entrusted with the actual arrangement and employment of these important means of defence. Continental Governments have also devoted much attention to this subject, and especially the Austrian Government, for whom Baron von Ebner devised an ingenious and elaborate system of electric torpedo defence, exhibited in detail at the Paris Exhibition of 1867, which received application during the recent war, though its efficiency was not actually put to the test except in the way of experiment.

The application of electricity to the explosion of torpedoes was very limited during the American war; but arrangements for the extensive employment of that agent as the exploding power were far advanced in the hands of both the Federals and Confederates at the close of that war. It appears that only in two instances of the entire number of vessels destroyed and injured was the explosion of the torpedoes effected by electric arrangements, the others having all been exploded by mechanical agency.

The explosion of submerged charges of gunpowder by mechanical contrivances, either of a self-acting nature or to be set into action at desired periods, was accomplished as far back as 1583, during the siege of Antwerp by the Duke of Parma. The English employed self-acting torpedoes against the French ships off Rochelle in 1628, and from that period to 1854 devices of more or less ingenious and practicable character have been proposed from time to time, and even applied to some small extent in different countries, for the explosion of torpedoes either by clockwork, at fixed periods, or by coming into collision with a ship. The Russians were the first to apply self-acting mechanical torpedoes with any prospect of success, and there is little doubt that had the machines which were applied to the defence of the Baltic been of larger size (they only contained 8 or 9 lbs. of gunpowder), their presence would have proved very disastrous to some of the English ships which come into collision with and exploded them. Various mechanical devices for effecting

the explosion of torpedoes by their collision with a ship were employed by the Americans during the recent war, a few of which proved very effective. But although, in point of simplicity and cost, a system of defence by means of mechanical torpedoes possesses decided advantages over any extensive arrangements for exploding submarine mines by electric agency, their employment is attended by such considerable risk of accident to those at whose hands they receive application that, under many circumstances which are likely to occur, they become almost as great a source of danger to friend as to foe. Thus the operations of lowering and mooring torpedoes, the explosion of which depends upon the application of a blow, thrust, or pull to some portion of the machine, which is so placed and arranged as to be in a favourable position for the application of mechanical action by a passing ship, are attended with very great danger to those employed, unless some means are adopted for rendering the exploding mechanism inactive until after the torpedo has been placed in position. But the employment of a safeguard of this kind involves a considerable amount of uncertainty as to the torpedo being rendered active, by its removal after the operation of mooring is completed, because this very removal is frequently a dangerous operation. Again, when once the mechanical torpedoes have been placed in position and rendered active, they are as dangerous to friendly ships as to the enemy; consequently their employment for the defence of a particular tract of water completely closes it until the torpedoes have been exploded or removed, and their removal obviously constitutes one of the most dangerous services upon which men can be employed. Several instances have recently occurred in America of the destruction of ships in waters defended during the war by mechanical torpedoes, of which it was believed that the subsequent removal had been completely accomplished. Some improvements have recently been made in mechanical and chemical appliances of a self-acting nature for torpedoes by the employment of which the mooring arrangements can be completed with perfect safety, and the torpedoes afterwards rendered active, by the performance of a simple and safe operation when it is desired to close the defended water. But the complete exclusion of friendly vessels, and the difficulties attending the raising of the torpedoes when no longer required, still constitute formidable objections against the use of mechanical torpedoes, excepting in the case of tracts of water which are not ordinarily navigated, but the passage of which in times of war might be attempted by vessels of light draft.

The most important advantages secured by the application of electricity as the exploding agent of submarine mines and torpedoes are as follows:—They may be placed in position with absolute safety to the operators; they may be rendered active or passive at any moment from the shore; the waters which they are employed to defend are therefore never closed to friendly vessels until immediately before the approach of an enemy; they can be fixed at any depth beneath the surface (while mechanical torpedoes must be situated directly or nearly in the path of a passing ship), a circumstance which very considerably simplifies the arrangements for their application in tidal waters; lastly, electric torpedoes may, when no longer required, be removed with as much safety as attended their application.

(To be continued).

On the Estimation of the Iodine of Commerce by Volumetrical Analysis.—M. Bobierre dissolves a weighed quantity of the iodine, the true value of which has to be estimated, in a concentrated solution of iodide of potassium, the solution is diluted to 100 c.c., and is dropped into an alkaline solution of arsenious acid of known strength. Instead of using starch water, as a means of recognising the end of the reaction, the author adds a few cubic centimetres of benzol to the solution of arsenious acid, and ceases to add more of the solution of iodine as soon as the former solution becomes rose-coloured. The arsenical solution is made by weighing off 49·95 grms. of arsenious acid and 14·5 grms. of crystallised carbonate of soda, and dissolving these in 1 litre of water, representing 12·688 grms. of iodine to the litre; 10 c.c. of this solution are taken for each assay, and 4 c.c. of benzol are added. —*J. de Pharmacie.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

May 6th, 1869.

Dr. A. W. Williamson, F.R.S., President, in the Chair.

Abstract of Mr. I. Lowthian Bell's *Lecture "On the Chemistry of the Blast Furnace."*

(Concluded from p. 234.)

One duty of limestone in blast furnaces, but not the only one, is to act as a flux, by melting and separating the solid impurities of the ore. It is usually considered that the use of an excess of lime promotes the separation of sulphur, and, it may be, phosphorus.

Mention has already been made of the difficulty of drawing any general conclusions respecting the progress of the operation of smelting from an examination of analyses of the solid contents of a blast furnace. It may be also questioned whether the current of gaseous matter would have anything like a uniform composition over any horizontal section corresponding to the point where the samples were taken.

Considering the properties of carbonate of lime when exposed to heat in an atmosphere of carbonic acid, the problem of drawing, from the presence of this gas, any general influence of the chemical change going on in a furnace, becomes very intricate, if, indeed, not impossible.

This salt of lime parts with half its carbonic acid at a moderate red heat, a much higher temperature being required before the whole is expelled; the last half, more or less, will not be set free until it meets with hot carbon, when it is instantly resolved into carbonic oxide.

Caustic lime is frequently employed in the operation, but this does not simplify the enquiry, but rather the reverse. Up to a temperature of redness, I ascertained lime absorbed carbonic acid in proportion to the temperature to which it was exposed—*i.e.*, the higher the heat the more rapid was the union; this increase went on until 19 per cent of the weight of the lime was taken up, after which a stream of the gas continued for nine hours produced no further change. On the other hand, carbonate of lime and caustic lime were subjected to a current of carbonic acid in a porcelain tube, and heated until the latter began to soften. In this case there was no absorption of carbonic acid, and, on the contrary, all the acid was drawn off from the carbonate.

So far as moderate temperatures are concerned, it was ascertained that caustic lime rapidly absorbs caustic acid from the escaping gases.

(To show the want of uniformity in composition of the gases from different depths of the furnaces, as determined by analyses, Mr. Bell exhibited diagrams, drawn to scale, in which the amounts of carbonic acid and carbonic oxide is represented by darker and lighter shades).

If the gases of a blast furnace have to furnish us with any data from which we may draw just conclusions of the nature of the chemical action going on in its interior, it appears to me little reliance can be placed on any analyses, excepting those of the gases as they escape.

It is not a difficult matter to calculate what the decomposition of furnace gases ought to be, supposing a certain quantity of coke and limestone to be consumed to the ton of iron, and the sole source of carbonic acid to be the ore by its deoxidation.

Assume the coke used to be 23·20 cwts., and the limestone 11·60 cwts. per ton of pig-iron, containing 19 cwts. of pure iron,

The coke may be taken as consisting of—

	cwts.
Pure carbon	21·80
Ash	1·40
	23·20

And the limestone will consist of—

	cwts.
Lime	6·50
Carbon 1·39 / Oxygen 3·71 } to form carbonic acid	5·10
	11·60

The ironstone will consist of—

	cwts.
Iron	19·00
Oxygen	8·14
Earths	22·86
	50·00

The total carbon, then, to be dealt with is, in—

	cwts.
Coke	21·80
Limestone	1·39
	23·19
From which must be deducted the carbon to combine with the iron—	0·74
Leaving to go off as carbonic acid and carbonic oxide—	22·93

The total quantity of oxygen we have in the minerals, applicable to oxidising carbon, is—

	cwts.
In the ore	8·14
In the limestone	3·71
	11·85
To which may be added from the decomposition of water contained in the blast—	00·85
	12·70

To convert 22·93 cwts. to the state of carbonic oxide, there will be required of—

	cwts.
Oxygen	30·57
But, as applicable to these, we have in the limestone 3·71, and in the water in the blast 0·85—	4·56
To be derived from the atmosphere.. ..	26·01

26·01 atmospheric oxygen is equal to nitrogen— 87·07

8·14 oxygen in the ore will give of carbonic acid, generated by its action on carbonic oxide— 22·38

22·38 carbonic acid contains 6·10 of carbon, having 16·83 (22·93 − 6·10) to give of carbonic oxide— 39·27

148·72

Supposing, then, the carbonic acid from the limestone to be decomposed, and that generated by the reduction of the ore to escape as such, the proportions in which nitrogen, carbonic acid, and carbonic oxide should be found in the escaping gases would be—

Nitrogen	58·54
Carbonic acid	15·05
Carbonic oxide	26·41
	100·00

Analyses of the gases from a blast furnace, melting forge iron with precisely the quantity of materials named in the above calculations, show figures in a close approximation to the theoretical calculation.

We will now devote a few minutes to an examination of the blast, by means of which we obtain heat from the fuel to fuse the iron slag, and generate carbonic oxide to effect the reduction and carburisation of the metal which is the object of the process.

The effect of cold on our atmosphere being to deprive it of a considerable portion of its moisture, and to contract its bulk, a cubic foot of air in winter contains, of course, less watery vapour and more oxygen than is embraced within the same space in summer.

The chief recommendation of the hot blast is the economy of fuel obtained by means of its use; and it is this attribute which possesses interest to ourselves as chemists, furnishing as it does a field of enquiry into the nature of combustion, and the appropriation of heat in blast furnaces.

If it can be shown that the progress of smelting science has been such as to reduce the consumption of coke in a furnace blown with cold air until it is within 10 or 11 cwts. per ton of iron of that used in a furnace supplied with air heated to 339° C., this is the saving we are called upon to explain.

Granting, then, for the present moment, that such saving, under the circumstances named, may be realised, it is to be remembered that the blast has the 339° of heat communicated to it by means of 5 cwts. of coal, of which, I have ascertained, more than one-half is wasted in the hot air apparatus; so that, practically, you have the heat of 2 cwts., or barely that, of fuel burnt outside the blast furnace, effecting a saving, in that burnt in its interior, of 10 to 11 cwts.

In practice, we are pretty near the truth in accepting as a fact, that an estimate of heat developed by the blast on the coke is obtained by considering its oxygen converted into carbonic oxide; for, although at the instant of its admission carbonic acid is generated, this substance is almost as rapidly converted into carbonic oxide by the action of the candescent coke. But, in the hot air stoves, the 2 cwts. of carbon are converted permanently into their highest state of oxidation; and, taking the units of heat as 2221° C. for burning carbon to carbonic oxide, and as 7900° C. for burning carbon to carbonic acid, the 2 cwts. burnt in the stove will represent 7·11 cwts. of carbon burnt in the furnace, or, say, something like 7¼ cwts.

In round numbers, therefore, we may consider 7¼ cwts. of our saving of 10 or 11 cwts. to be accounted for, leaving still 2¼ or 3¼ cwts. for further investigation.

Now, let us assume that the coke required is 40 cwts. for the ton of cold blast iron, and in the furnace, blast heated to 339° C. is suddenly introduced, which is equal in caloric power to 7¼ cwts. of coke; so that, so far as a mere question of heat is concerned, something like 47¼ cwts. of coke is being applied to the production of a ton of metal for which 40 cwts. will suffice.

A common yield of calcined clay ironstone is 40 per cent; so that 50 cwts. are required for a ton, to which has to be added, say 12 cwts. of limestone.

The burden, then, for 1 ton of cold blast iron would be—Coke 40 cwts., calcined ironstone 50 cwts., limestone 12 cwts; but, by the addition of the equivalent of 7¼ cwts. of coke, these proportions will require a corresponding modification, and a ton of iron will be represented by heat in blast 7¼ cwts., and in coke 32¼ cwts., together 40 cwts.; calcined ironstone and limestone, as before, 62 cwts. together.

But what is the effect on the furnace itself by such a change in the proportion of its contents? To answer this, let us imagine a furnace with a capacity of 6,000 cubic feet.

The weights of the materials used at the Clarence Works have been carefully ascertained; and it was further determined that the weight of material in a furnace, before being lighted, was such as to cause a compression like 25 per cent; so that a furnace of 6,000 cubic feet would contain 7,500 cubic feet of materials, as measured in the charging barrows.

It therefore appears such a furnace, working on cold blast, would contain—

	tons.
Coke	56
Calcined ironstone and limestone ..	87
	143

But, introduce the air, heated so as to reduce the coke to about 30 cwts. to the ton of iron, and the furnace would contain—

	tons.
Coke	50
Calcined ore and limestone	103
	153

It would be almost impossible to ascertain to what extent these figures become modified by the action of the heat when the furnace is in blast, or what the effect of the altered proportions would be on the temperature of the ascending gases. To obtain the exact figures for this, we ought to have the specific heat of all the various materials in the furnace.

That the withdrawal of so many cubic feet of coke, and its substitution of substances nearly three times its weight, and with a mean specific heat rather higher than that of the coke itself, must permit a more perfect absorption of heat from the ascending current of gas, is obvious.

Looking at the complicated nature of the problem, it appears as if there is no alternative left but to ascertain the actual amount of heat carried off in the escaping gases, after they have performed their work in the furnace; and this, during a whole day, was done at the Cyfarthfa Works, in a hot and cold blast furnace.

The temperature of the gases was ascertained by a pyrometer, consisting simply of a copper tube, about 3 feet long and 1 inch diameter, closed at the lower end, and screwed into a Bourdon's pressure gauge.

The gases were assumed to contain according to weight—

$9CO_2$, 32CO, 59N = 100.

	cwts.		cwts.		cwts.
The C in CO_2 = 2·45 ;	C in CO = 13·71.	Total C ..	16·16
The O in CO_2 = 6·55 ;	O in CO = 18·29.	Total O ..	24·84
Total CO_2 .. 9·00.	Total CO .. 32·00.	Total C+O	41·00

	cwts.	cwts.
Coke used per ton of iron was—		34·80
Deduct ash (5 per cent)	1·74	
Deduct HO (5 per cent)	1·74	
Deduct for combination with iron	0·74	
		4·22
		30·58
Carbon in limestone		2·12
Total carbon going off in gases ..		32·70

With the composition of the gases given above, the carbon will be volatilised in the following state :—

	cwts.
CO_2	4·96
CO	27·74
	32·70

	cwts.
C 4·96, for conversion to CO_2, requires O ..	13·23
C 27·74, for conversion to CO, requires O ..	36·99
32·70 Total O	50·22

But in the materials themselves there is—

O in the CO_2 of the limestone used (17·66 cwts. per ton of iron)	5·65	
O in 48·43 ores (part of Fe being as FeO)	7·35	
		13·00
Having to be supplied by blast of O		37·22

The total weight of the gases would then be—

	cwts.
Carbon	32·70
Oxygen	50·22
Nitrogen, accompanying 37·22 O of blast	124·60
Water in coke 1·74 ; water in ore 2·19 ..	3·93
	211·45

We have a total weight of gases—

	cwts.
C 4·96 + O 13·23 = CO_2	18·19
C 27·74 + O 36·99 = CO	64·73
N	124·60
HO	3·93
	211·45

The mean temperature of these gases as they left the furnace was ascertained to be 445° C.

By multiplying these weights by their various specific heat and temperature we have—

$$\left.\begin{array}{l} CO_2\ 18{\cdot}19 \times 0{\cdot}212 \times 445^\circ \\ CO\ 64{\cdot}73 \times 0{\cdot}288 \times 445^\circ \\ N\ 124{\cdot}60 \times 0{\cdot}275 \times 445^\circ \\ HO\ 3{\cdot}93 \times 1{\cdot}000 \times 445^\circ \end{array}\right\} .. .. .. 269{\cdot}67$$

And this divided by 2221 units of heat burning C to CO, gives 12·16 cwts. of carbon, or, say, 12·76 of dry coke, as going off with the escaping gases from the cold blast furnace.

In the case of the hot blast furnace, with air heated to 320° C., the calculation stands thus :—

		cwts.
Coke used per ton of iron was		26·74
Deduct ash in coke (5 per cent) ..	1·33	
,, HO ,, (,,) ..	1·33	
,, C to combine with iron ..	0·74	
		3·40
		23·34

Lime added in caustic state; hence there is no carbon to include from this source. Upon the same basis as the previous calculation, the carbon will be given in the gases as—

	cwts.
CO_2	3·53
CO	19·81
	23·34

	cwts.		cwts.
C 3·53	requires for conversion to	CO_2 of O	9·41
C 19·81	,, ,, ,,	CO of O	26·41
23·34			35·82
Less O in the ores, part existing as FeO ..			8·12
Leaving O to be supplied by blast			27·70

Total weight of gases will be—

	cwts.
Carbon	23·34
Oxygen	35·82
Nitrogen accompanying 27·70 O ..	92·73
Water in coke, 1·33, in ore, 1·73 ..	3·06
	154·95

The mean temperature of the gases are ascertained to be 477° C., and their estimated constitution would be as follows :—

	cwts.
C 3·53 + O 9·41 = CO_2	12·94
C 19·81 + O 26·41 = CO	46·22
N	92·73
HO	3·06
	154·95

By multiplying these weights by temperature and specific heat we have—

$$\left.\begin{array}{l} CO_2\ 12{\cdot}94 \times 0{\cdot}212 \\ CO\ 46{\cdot}22 \times 0{\cdot}288 \\ N\ 92{\cdot}73 \times 0{\cdot}273 \\ HO\ 3{\cdot}06 \times 1{\cdot}000 \end{array}\right\} \times 477^\circ = 21274$$

This divided by 2221 = 9·57 carbon, or dry coke, 10·04.

	cwts.
Now, as the weight of coke per ton of iron escaping represented in heat from the cold blast furnace has been shown to be	12·76
Whereas with hot blast it is only	10·04
It follows there is escaping from the former above that going off from the latter heat equal to coke	2·72

We have the total saving of coke as follows:—

	cwts.
1st. By use of blast heated as formerly stated	7·50
2nd. By diminution of loss of heat in the escaping gases	2·72
	10·22

which accords with the saving stated to be effected by the use of 5 cwts. of coal, of which only about 2 cwts. were really available.

Mr. Bell concluded his paper by giving in detail several other comparisons of two different furnaces carried on with cold and hot blast respectively.

The PRESIDENT, in inviting discussion, said—There is scarcely any branch of manufacture which requires so many various qualities of a rare and high kind as this particular one in which Mr. Bell is pre-eminent, and, certainly, among iron-masters there is none equal to himself in the combination of those various qualities. His scientific skill and industrial vigour have led to the construction of iron furnaces which are unsurpassed in the perfection of the operations which pertain to them. The subject is one so complicated that Mr. Bell's views will be considered exceedingly valuable in relation to it, and, certainly, all will feel interested in having so full and so masterly an exposition from himself in this matter.

Mr. SIEMENS—With regard to the saving effected by hot blast, a great deal of controversy has taken place, and I am very glad to see that Mr. Bell has really tackled the question by reducing it to figures. At first sight it appears strange that the combustion of 2 cwts. of carbon added to the blast should save 10 cwts. of coal in the blast furnace; but a little consideration, I think, would bring us already to this conclusion. If the result of combustion was carbonic acid only, then every 6 lbs. of carbon added in the shape of heat to the blast would necessarily save 14 lbs. in the furnace, that being the proportion of heat developed in burning carbon into carbonic oxide and into carbonic acid; but we find the result of combustion is not carbonic oxide but a mixture of carbonic oxide and carbonic acid. It may be assumed to be, in a furnace worked with hot blast, 1-5th carbonic acid and 4-5ths carbonic oxide; and, if we take these proportions, we shall find that the effect of 1 lb. of combustion outside the furnace would probably produce a saving of 4 lbs. inside the furnace. But why is the saving greater? If we suppose that a mixture of air, reduced ore, and carbon, comes down the furnace, and it is met by the blast, the first action is complete combustion into carbonic acid; but almost simultaneously with that action the reducing action, or the absorbing action of the carbonic acid upon carbon, takes place also. The carbonic acid is reduced to carbonic oxide, and this reduction is accompanied by a great refrigerating effect. If cold blast is used, there must be a larger proportion of carbon present with the ore, and there must be a larger surface of carbon at once exposed to the carbonic acid formed in order to effect its reduction. It has been determined practically that a cold blast furnace not only works hotter at the top, but that the proportion of carbonic acid is greater in the case of a hot than a cold blast furnace; it would, therefore, follow that the hot blast has not only produced a higher temperature at the bottom, but reduced a mixture of carbonic oxide and carbonic acid, giving larger margin of heat developed, or less refrigerating action introduced by the formation of carbonic oxide. Perhaps Mr. Bell will be kind enough to tell us whether, on raising the temperature of the blast, the proportion of carbonic acid gas at the top of the furnace is not increased.

Mr. BELL—If you had a hot and cold blast furnace working together, irrespective of the results, with the same quantity of fuel, and the same quantity of ore, then the comparison Mr. Siemens is making would be a perfectly true one. But it happens to be the case that, upon a comparison of the Clairvale furnace, blown with a hot and with a cold blast, you find the volume of carbonic acid in the cold is considerably greater than that in the hot.

Dr. PAUL—If we compare two furnaces, one worked with cold blast, and burning fuel at the rate of 2 tons for each ton of iron produced, and a hot blast furnace, worked so that the consumption of the fuel is at the rate of only 1 ton for each ton of iron produced, we must remember that, in fact, the largest proportion altogether of the materials passing through those furnaces in both cases is the air by which the combustion is supported. Therefore, taking it for granted that in both cases the discharged gases go away at the same temperature, we have in the one blast furnace twice the amount of gaseous material passing through the furnace, and twice the quantity of heat being carried off in that escaping gas. Therefore, it is evident that the quantity going away to waste in the cold blast furnace is twice as great as in the hot blast furnace, and if we had the waste twice as much in the one case as it is in the other, it is very evident that in the hot blast furnace there must be very considerable saving.

Captain NOBLE—With respect to the ratio between carbonic acid and carbonic oxide in the waste gases, Mr. Bell has found that, within a very short time, and while apparently the furnaces are working precisely the same, there is a very great difference in their ratio. I entirely agree with what Mr. Bell has said, and I believe very little in the analyses of tunnel-head gases. The analyses of gases taken from pipes are, I believe, entirely fallacious. It is almost impossible to believe that ratios in crooked lines, like what we see on the diagram, can really exist in a furnace, and it is very evident that when we take gas from a furnace by means of a small pipe, the nature of that gas will change very much in accordance with the last substance with which the gas has come into contact—whether it be coke, for example, or whether it be ironstone. I have had occasion myself recently to make an investigation with reference to the determination of the number of units of heat produced in a furnace, and what became of them. In so doing, I have endeavoured to trace the number of units of heat that go away with the tunnel-head gases, and which are re-produced again when the tunnel-head gases are burnt, and so on. And, finally, I have worked it out in the work that is done by the engines and other means. The great variations that Mr. Bell has found in his analyses of his gases from the pipes is entirely confirmed in another way, and that is, by the amount of water vaporised. In the space of three or four hours the amount of water vaporised varied most enormously, and, if I remember right, Mr. Bell found a variation in the ratio of the carbonic acid amounting to something like 20 per cent of the whole amount. The ratio also varies much in the different furnaces.

Mr. CROSSLEY—It is certainly surprising to find that iron absorbed carbon at so early a stage in the furnace. I have passed pure carbonic oxide over pure sesquioxide of iron, and I never noticed any deposition of carbon, and I am rather afraid that, in the case of Mr. Bell, the calcined stone has not been fully calcined in the interior of the stone, and perhaps the carbon which he has obtained in the deposit is the carbon which was left in the stone. Mr. Bell has also told us something which I consider very interesting in reference to the proportion of limestone that may be used in a furnace, and he stated that the smaller the quantity of limestone used the larger the percentage of sulphur which comes off in the pig-iron. We tried some years ago some experiments in which we

used 3½ cwts. of limestone, 7 cwts., and, I believe, 14 cwts., and we have found that the silicon and the sulphur in the iron came off in larger quantities in the iron where the smallest quantity of limestone was used, and there was a smaller proportion of metallic bases in the pig-iron produced from the smallest quantity of limestone.

Mr. Cochrane—I shall be glad to offer a few observations on the subject of hot blast, which has been rather a pet subject with me for a great many years. I believe it is an admitted fact, that the colder oxygen is, and, of course, the more dense it is, the more intense is the action of combustion due to that oxygen, and that there is no advantage in warming it. But not so, I believe, with nitrogen, and, of course, with the mixture of atmospheric air. I think that the question of heating that mass of nitrogen has been rather overlooked in the paper; and, not only has an enormous amount to be heated in the furnace, but, I believe, a greater weight of nitrogen has to be heated for every ton of iron that is reduced. Mr. Bell has alluded to a dark appearance before the tuyere. It is notorious that this dark appearance extends, in many instances, to a long tube, right into the centre of the cold blast furnace; and that is really part and parcel of the heating apparatus which enables the blast to be delivered in the cold blast furnace at the requisite temperature for the quality of iron required. Hence it needs the element of time of combustion to be taken into account, or not the time of combustion rather, but that the material—the coke—is, in being burnt, higher in a cold blast furnace, by reason of the time required for heating all the nitrogen, and so on, than is the case in a hot blast furnace, where you start with temperature of, we will say, 1000° F., and where there is no longer any necessity for heating that blast inside the furnace. The zone of fusion is spread lower down the tuyeres, and so, *pro tanto*, you gain in height of furnace.

Mr. Bell—I will not take up many minutes in replying to the questions which have been put before us. One point raised was as to the greater volume of gases escaping from a cold blast furnace than from a hot. Well, I have not given figures on that point, because, as I stated before, I have intruded too long upon the company already. But it was, of course, impossible to ascertain the quantity of heat escaping by the gases at a certain temperature, unless I had known the quantity of gases escaping, which was a necessary element in the calculation. With respect to the observations of Mr. Crossley, with regard to the possibility of the carbon in the ironstone being the cause of the deposition of the carbon in the iron, I would remind him that a certain temperature was required. If this was deposited from the carbonic acid already existing in the iron ore, how did it happen that it never found its way there, when it was exposed merely in a blast furnace having the escaping gases going out at a temperature something like melting lead? There was an invariable connection between the temperature of the escaping gases and the appearance of this carbon. With regard to my friend Mr. Cochrane, all I can say is this, that I am not prepared to dispute whether it is better to heat the oxygen or better to heat the nitrogen. But this appears to me quite certain, that, as you look upon the blast as a mere vehicle for conveying the heat, it is a matter of perfect indifference whether the heat is carried in by 8 lbs. of oxygen or 14 lbs. of nitrogen.

I have made diagrams, not from imagination, but based upon actual analyses of the gases, to show that, at a given point, the whole of the oxygen of the blast is absorbed, and whether the blast went in hot or cold appeared to make no difference. The carbonic acid was as readily reduced to the condition of carbonic oxide in the hot blast as in the cold. The figures before you illustrate quite truly the temperature of the gases as they were coming from two furnaces and at different periods of the day; and they merely show the irregularity of action of all blast furnaces, and how impossible it is, from a few observations, to draw any general expression as to their action.

Mr. W. Chandler Roberts then gave a verbal account of, and exhibited, the apparatus for showing the expansion of palladium by hydrogenium. It consisted of a coil formed with a strip of palladium and a strip of platinum, each being 300 m.m. long, 3 m.m. wide, and 0·3 m.m. thick. This is put into a glass vessel filled with acidulated water; a plate or wire of platinum is placed near it, and the ribbon or wire connected with either pole of a battery by means of a commutator. The coil is first connected with the zinc pole of the battery, hydrogen is then thrown on the surface of the palladium, when the gas is absorbed and the spring opened. The direction of the current being reversed, oxygen is thrown on the surface of the metal, which consumes the previously occluded hydrogen and causes the index to move rapidly back to zero.

FRENCH ACADEMY OF SCIENCES.

Monday, May 10th, 1869.

Some very interesting papers were read, but, inasmuch as some of these do not belong to chemistry, or sciences intimately connected therewith, we confine our report to what chiefly interests our readers, and, in the first place, we notice some communications by the Rev. Father Secchi, S.J., "*On the Spectrum of the Sun's Spots.*" The learned astronomer having found that the spectrum of red coloured stars contains lines indicating the existence of carburetted hydrogen, has searched the spectrum of the sun's spots and faculæ, in order to detect therein, if possible, similar lines; and he has been successful in finding the same. We regret that we can only briefly notice this very important communication, since, without diagrams and woodcuts, it is not possible to enter fully into this subject.

M. Kerikuff has addressed a brief note to the Academy on the subject of the scintillation of the stars. He states that, so far back as the year 1861, he had given an explanation of that phenomenon, identical with that lately set forth by M. Respighi. The note is handed over to a committee, for enquiry and report thereupon.

On behalf of M. Le Roux, M. Edmond Becquerel read a communication "*On the Phenomena of Electric Light and Phosphorescence in the midst of (au sein de) Rarefied Gases.*" According to the author's statement, it is not at all necessary that an electric current should be made to pass through a gas: electricity by induction is sufficient to exhibit the phenomena. When a toothed wheel which is electrified is rapidly set in motion in close proximity to a tube containing any well-suited rarefied gas, the tube becomes illuminated and the gas phosphorescent.

M. des Cloizeaux read a paper on the crystalline form, the optical properties, and chemical composition of gadolinite, a rather rare mineral, some specimens of which exhibit double refraction, while others again do not. The mineral has been found hitherto only in Norway, near Hitteroe, and in Sweden, near Ytterby. The name of the mineral is derived from M. Gadolin, a Russian chemist, who first discovered this substance, and proved it to contain yttria and glucina, as well as the oxides of cerium, of lanthanium, and silica. M. des Cloizeaux states that the mono-refracting crystals ought to be referred to the epidote. The percentage composition of the gadolinite from Ytterby is, according to Dr. Berlin's analysis, quoted by the author—Silica, 25·62; oxide of yttrium, 50·00; oxide of cerium, 7·90; protoxide of iron, 14·44; lime, 30·00; magnesia, 0·54; alumina, 0·48; potassa, 0·19; soda, 0·18. Total, 100·65.

Our readers, on referring to our report of the meeting held on the 3rd of May, will find that M. Berthelot read a memoir on the chemical equilibrium between carbon, hydrogen, and oxygen. At this meeting the said gentleman read the concluding portion of his work. The chief

fact observed is, that the decomposition of carbonic acid by the electric spark does not come to any fixed end—in other words, does not proceed beyond a certain limit—because the oxide of carbon and oxygen resulting from the decomposition of the carbonic acid have a tendency to become combined again and re-constitute carbonic acid.

M. SAINTE-CLAIRE-DEVILLE made a statement about his meteorological experiments and observations, from which he concludes that the changes of temperature are subject to periodical variations, returning regularly after 90, 30, and 10 days, due to and caused by the passage of our earth through different portions of the space of the universe. The same gentleman and M. Silbermann had a long discussion on the subject of the cause of the aurora borealis, which led, however, to no result of any importance to the general scientific public.

On behalf of M. Margueritte, M. Sainte-Claire Deville read a note setting forth the objections they have to make against the theory of M. Dubrunfaut concerning the supersaturation of sugar solutions in alcohol. The author says that Dubrunfaut has not proved by any experiment that when crystallisable sugar is dissolved in water, and alcohol added, any change should take place in the sugar itself. It is, therefore, evident that nothing else happens than the return to the solid state of a substance previously dissolved, and the crystallisation of which was impeded either by the presence of water, or some other unknown cause.

NOTICES OF BOOKS.

A Course of Six Lectures on the Chemical Changes of Carbon. By WILLIAM ODLING, M.B., F.R.S., Fullerian Professor of Chemistry, Royal Institution. Delivered before a Juvenile Auditory at the Royal Institution of Great Britain during the Christmas Holidays of 1868-69. London: Longmans, Green, and Co.

FEW men who have ever devoted themselves to chemistry, forget their first attendance at a chemical lecture. The lecturer may not be profoundly learned, or even a brilliant manipulator—he may use hard words, and omit to explain them; he may totally fail in some experiments, and only partially succeed in others—it matters not; to an intelligent and imaginative boy there is a magical charm about the new world thus opened to his mind which time can never efface.

But replace the school-room by the theatre of the Royal Institution, the amateur or itinerant lecturer by Faraday, the imperfect apparatus by all the appliances which refined science can suggest; can we then wonder if the impressions so formed exercise a lasting and glorious influence over the mind of the youthful spectator?

Only those who have seen the rapt and delighted gaze of the juvenile audiences, as they followed, with intelligent appreciation, each experiment and explanation of Faraday, can fully appreciate the enormous amount of good which must arise from these lectures.

The worthy successor of Faraday, in his Chair at the Royal Institution, has so far followed in the footsteps of his predecessor, that he has continued to give lectures to the young, and with eminently successful results.

The present series of lectures on the chemical changes of carbon will be found to contain all that can be said upon the subject capable of being comprehended by a juvenile auditory; and being printed as they were taken down *verbatim* by the reporter of the CHEMICAL NEWS, they possess all the vivacity, as well as originality and clearness of style, which distinguish the eminent chemist by whom they were delivered.

A remarkable feature in these lectures is the fact that every term made use of is defined as it occurs, and the oral definition is supplemented by a clear and decisive experimental illustration.

It must not be forgotten that *Carbon*, in some respects, stands alone among the elements. Its compounds are more numerous than those of any other element, and their history by the older chemists was considered to constitute a distinct branch of the science, and called "Organic Chemistry." In the present day, the results of research have been to break down the barriers which were supposed to exist between organic and inorganic chemistry; and it has been found that a vast number of bodies, at one time supposed to be producible only by the agency of animal or vegetable life, can now be formed by the chemist from absolutely inorganic matter. The result of these discoveries has been that the phrase "Organic Chemistry" is, by the more advanced chemists, abandoned for the more accurate term, "Chemistry of the Compounds of Carbon."

While reminding our youthful readers that the chemistry of carbon includes the chemical history of all animal and vegetable substances, we cannot, we think, offer them better advice than to commence that grand study by a careful perusal of Dr. Odling's Lectures "On the Chemical Changes of Carbon."

Chemical Labels, according to the latest System of Nomenclature. London: H. K. Lewis. Price 1s.

A series of Chemical Labels, with Symbols, arranged according to the New Notation. Leeds: Harvey, Reynolds, and Co. Price 6d.

Complete Series of Photographic Labels, including Solids and Solutions, with Duplicates and Blank Labels. Leeds: Harvey, Reynolds, and Co. Price 6d.

Mawson and Swan's Book of Chemical Labels. Revised Edition. Newcastle-on-Tyne: Mawson and Swan. Price 1s.

FEW things are more necessary for a chemist's laboratory than good, boldly-printed labels, and, for the student of the present day, it is almost essential to use those in which the old and new formulæ are given.

The first of these series has been very carefully compiled by Mr. Henry Matthews and Mr. C. W. Quin, whose names alone are sufficient to guarantee an expenditure of time and thought in their arrangement, which cannot fail, in a great measure, to meet the requirements of the analytical chemist. The compilers have, we think, been judicious in selecting labels for those tests and reagents only which are in constant use.

Messrs. Harvey and Reynolds's series are arranged according to the new notation, and only the new formula is given; the type is clear and distinct, and the book is well worth the moderate sum charged for it.

Photographers will do well to avail themselves of the useful and complete set of labels for photographic chemicals, which appears to contain all the solids and solutions in present use. We would, however, suggest that, in a new edition, the word *poison* should be annexed to such substances as cyanide of potassium, &c.; for, although it is not customary for wholesale houses to take this precaution, it is highly necessary for it to be observed, where poisons are in constant use; and especially for cyanide, which is used in solution for fixing positives, by young amateurs and others, who are not always the most careful with poisons.

We are glad to find that the revised edition of Mawson and Swan's labels is free from the many imperfections of the first. The labels are alphabetically arranged, with the inner margins perforated. The names and formulæ accord with the latest editions of "Fownes," "Roscoe," and "Fresenius," while, in most instances, the old names and formulæ are given in italics. The term *acid* is restricted to hydrogen salts, and the specific gravities of the strong and dilute acids as well as the proportions of acid to water are given. Labels intended for solutions of salts bear the word "solution," and the various states of tests and

reagents are appended, thus obviating the practice of using the same label for a salt, whether it contains water of crystallisation, or is in a state of fusion, or in solution. We can certainly say of this edition what we could not conscientiously say of the first, that it has been compiled with an amount of care and attention which could only be bestowed by a chemist well versed in both the old and new systems of nomenclature and notation, and fully maintains the high character the publishers have attained as manufacturers of chemical apparatus and pure chemicals.

CORRESPONDENCE.

EQUIVALENCE AND QUANTIVALENCE.

To the Editor of the Chemical News.

SIR,—I would suggest that the quantivalent discussion has not made good progress.

Mr. Orme unfairly insists that equivalent notions involve an "equivalent weight" of nitrogen in ammonia to be ⅓, &c., &c.

Between the modern views of "atomicity," as cautiously put forth by Wurtz and other leading chemists, and the older views of "equivalents" there is, I moot, *no essential difference*. To both the N of ammonia is equally triatomic or trivalent.

But Mr. Attfield takes up an entirely new position, viz. —that quantivalence is an essential quality *per se*. If it could be shown that N is equally trivalent in nitrous oxide, nitric oxide, nitric acid, the peroxide, and also in nitric acid, and similarly for other multiple combinations, then the matter would be settled.

It is true that ammonia is a leading and characteristic type of combination between N and H, but it is not exclusively such.

The ratio is—

1 to 2 in amidogen.
1 to 3 in ammonia.
1 to 3½ (2 to 7) in atmonium ?
1 to 4 in ammonium.

The atmonia ? type is not well recognised, but it is becoming very prolific in the innumerable amides, ureas, ureides, &c., &c.—I am, &c.,

CHEMICUS.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the very generally expressed wishes of our friends and readers, we have endeavoured to effect arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

Annalen der Chemie und Pharmacie, April, 1869.

The following are the original papers which appear in this number:—"*On Salicyl Compounds*," by Schröder and Prinzhorn.—"*On Propylphycite and some Substances allied thereto*," by J. G. Wolff.—"*On a New Method of the Formation of Glycogollamide, and on the Constitution of Urea*," by Heintz.—Second part of lengthy treatise of A. Liebmann "*On the Synthesis of Alcohols by Means of Chlorurated Ether*."—Reply from A. Strecker to M. Maly's criticisms on Strecker's paper "*On the Identity of the so-called Abietinic Acid and Sylvinic Acid*."

The above papers are treatises and essays rather than papers, and are so concisely written as to be unfit for condensation.

Moniteur Scientifique, No. 297, 1869.

The Use of Bran in Brewing, Manufacture of Spirits and Starch Making.—Since bran contains from 40 to 60 per cent of its weight of starch (farine), M. Poncelet proposes to use a certain quantity of bran instead of malt or raw grain for the purposes of brewing, making spirits from grain, and the manufacture of starch. He either uses the bran as it is, or extracts the starch from it previously, and adds this substance to the materials required for the mash-tubs.

The Substitution of Alum-shale for Bone-Black in Sugar Manufacture.—M. Belin proposes to do away with the use of animal charcoal for sugar manufacturing purposes, and to substitute instead the exhausted alum-shale after it has been applied to the manufacture of alum, or sulphate of iron. 100 parts of juice from beet-root require from one to eight parts of the exhausted shale. The liquid, after having become clarified, is evaporated to 26 degrees Beaumé in contact with air without any previous filtration, and next concentrated in vacuum pans to 43 degrees. The concentrated syrup thus obtained is run into large iron tanks and left to crystallise. The only advantage gained by this process is, beside the saving of animal charcoal, the obtaining of molasses better fit for the distillery of spirits usually connected with beet-root sugar works.

Sulphurous Acid for Dissolving Bones.—It is well known that hydrochloric acid is used for the purposes of dissolving the earthy salts of bones, in order to obtain the gelatine they contain in such a state as to render that substance readily soluble in boiling water. The use, however, of hydrochloric acid is rendered rather inconvenient for this purpose, on account of the formation of chloride of calcium which interferes with the drying of the gelatine. M. Coignet, at Paris, has found that sulphurous acid answers the purpose of hydrochloric acid in this instance perfectly well. The bones are placed in cold water, and through the water a current of sulphurous acid gas is forced so long as is required to completely soften the bones, which are afterwards washed in fresh water wherein some sulphurous acid gas has been previously dissolved.

Les Mondes, May 6, 1869.

Oxyhydrogen Light.—The following description is given of the experiments which are every evening made at 44, Rue Lafitte, Paris, with the above-named light:—The burner, which is arranged to burn either pure hydrogen gas or coal gas at any pressure from 2 millimetres up to several centimetres, is constructed in the following manner:—The oxygen issues from a central opening, the hydrogen or coal gas issues from small tubular openings, not unlike those met with in the Leslie gas-burner; but instead of being as in that burner almost vertical, they are in this instance bent so as to lay almost horizontal, and thus stand with the openings opposite to each other, while the oxygen is in the centre; the flame is directed against a piece of zircon-magnesia. We further notice a circular Argand burner without any magnesia cone, and so arranged as to have the combustion of the gas supported by oxygen gas instead of by air. A modification of this burner, as regards the arrangement of the supply tubes, is made to serve for burning gas fed by oxygen, the burner being placed in strong glass globes so as to suit the purposes of lighting mines and for submarine lamps. Care has been taken by proper and suitable means to carry off the products of the combustion in each case in such manner as to insure the safe use of the apparatus.

Bulletin Mensuel de la Société Chimique de Paris, No. 4, 1869.

This number contains the following original papers:—

Discovery of a New Base.—M. Wurtz has succeeded in obtaining a new base by making chlorhydrate of glycol act upon toluidine at a temperature of from 200° to 220° C. This substance exhibits a beautifully green fluorescence, has a bitter state, is precipitated by a solution of iodine in solution of iodide of potassium. It contains H_2 less than toluidine, while for two other hydrogen atoms are substituted a vinyl and hydroxethylen group. The chloroplatinate of the base is a crystalline substance readily decomposed by heat.

Two replies, rather than papers, by Messrs. Fittig and Wurtz, to criticisms made upon their work are of no particular interest. Concluding portion of Berthelot's paper "*On the Universal Method of Reducing the Hydrogen of Organic Compounds.*" "*On the Detection of Sulphur by the Spectroscope*," by M. Salet. This is a re-discovery of Mr. Barrett's researches on this subject published some years ago in the *Philosophical Magazine*.

On a Substance Homologous with Borneo Camphor.—The substance known in perfumery and pharmacy as patchouli camphor is, according to recent researches of M. Gal, a substance homologous with Borneo camphor, which is represented by $C_{20}H_{18}O_2$. The average results of several elementary analyses of patchouli camphor gave for 100 parts:—C, 80·1: H, 12·6; the formula just quoted requires C, 80·3; H, 12·5; the vapour density of this substance taken at 324° is 8·00; patchouli camphor is solid, fuses between 54° and 55°, and boils at 296°; its specific gravity is 1·052, at a temperature of 4·5° C. The camphor is insoluble in water, readily soluble in alcohol and ether; it crystallises in hexagonal prisms. While Borneo camphor is a right-handed rotatory substance, the patchouli camphor is left-handed. When patchouli camphor is distilled with chloride of zinc at between 248° and 252° C., it yields a carbide of hydrogen, $C_{20}H_{16}$. The essence of patchouli is isomeric with the camphor, which is, it appears, simply formed by a molecular change.

On the Acetone of Formic Acid.—M. E. Mulder instituted the following experiment in order to prove that methylic aldehyde and acetone are identical, and must be both expressed by the formula,

H_4CO,H_2. The author has submitted formiate of lime to distillation, and has obtained a liquid which reduces silver salts to metal readily, and is, moreover, possessed of all the properties of Hofmann's methylic aldehyde.

On Nitroglycerine.—M. Tilberg has made some researches on this substance, making use of the nitroglycerine manufactured on the large scale at Stockholm. This material is decomposed by potassa, giving rise to the formation of nitrate of potassa and glycerine; but, at the same time, there are formed secondary products, as ammonia, cyanogen, oxalic and ulmic acids, and nitrous acid. According to the results of elementary analysis made by the author, the formula for this kind of nitroglycerine should be $C_3H_5(NO_2)3O_3$. The substance is soluble in concentrated sulphuric acid, yielding a clear solution, and forming a sulphoconjugate which, on being combined with bases, gives crystallisable salts.

On some New Combinations of Orcine.—M. V. de Luynes observed that orcine combines directly with picric acid, when that acid is mixed with water in too small a quantity to admit of its solution. On raising to the boiling point, orcine is added gradually until all the picric acid has disappeared. On cooling, crystals are deposited which have the appearance and colour of bichromate of potassa. These crystals are deliquescent, soluble in water, alcohol, and ether, and decomposed by benzol, which takes up the picric acid and leaves the orcine. They are represented by the formula—

$$C_{12}H_3(NO_4)_3O_2,\ C_{14}H_9O_4 = C_{26}H_{11}N_3O_{12}.$$

Orcine combines directly with nicotine, forming a rose-coloured solution. When previously fused orcine is placed under a bell-jar filled with gaseous oxide of ethylen, the gas is absorbed, and the orcine liquefied. An aqueous solution of orcine dissolves rosaniline, partaking of the colour exhibited by the solutions of that substance. It would appear that orcine also combines with common salt.

A New Compound of Lime and Sugar.—Messrs. Boivin and Loiseau have formed a new combination of lime and sugar which, moreover, contains carbonic acid. It is prepared in the following manner:—To 200 kilos. of syrup containing 60 per cent of crystallisable sugar, 120 kilos. of caustic lime as a thickish milk of lime are added, and next carbonic acid gas is passed through the mixture. After some time a precipitate is formed, and as soon as it makes its appearance, 20 litres of tepid lime-water are added, and the stream of carbonic acid gas is stopped. The precipitate just alluded to is the new compound, and it contains in 100 parts, 43 of sugar, 40 of lime, and 17 of carbonic acid.

Fluosilicic Acid for Sugar Refining.—It appears that M. Marix has taken in France a patent for the application of fluosilicic acid for the purifying of beet-root and other saccharine juices. The saccharine fluids are first diluted with a sufficient quantity of water to take away the viscosity of these fluids, sufficient fluosilicic acid is then added to precipitate all the potassa salts present, and next powdered chalk is added to saturate any excess of the acid. The fluid is then filtered in order to obtain a clear liquid, and this afterwards treated in the usual manner.

Bleaching Paper Pulp.—M. Gauny proposes to bleach paper pulp by means of bichromate of potassa. For 100 kilos. of pulp (supposed to be dry) he uses 50 kilos. of bichromate and 150 kilos. of hydrochloric acid, mixed with a sufficient quantity of water to make the pulp float. After twelve hours' standing, the chloride of chromium is washed out by means of clean water, and the pulp treated with a small quantity of bleaching powder to make it thoroughly white. The chloride of chromium is precipitated by means of excess of lime, and this mixture calcined in a reverberatory furnace, where it is converted into chromate of calcium.

Many of the papers and short notices in this periodical appeared some years ago in the Chemical News. Some are eleven years old.

Journal für Praktische Chemie, No. 3, 1869.

This number contains the following original articles:—

Extraction of Zinc from its Ores by the Wet Way.—It appears that, in consequence of the scarcity of fuel, and the poverty of the main bulk of the zinc ores now found in Silesia, Prussian Empire, M. O. Jungkann has been making experiments to try to find a method of extracting from the ore there found the zinc it contains in a quantity of from 7 to 10 per cent, by the so-called moist way; the ore is calamine stone, or carbonate of zinc mixed with impurities, as oxide of iron, sand, alumina, lime, and magnesia. Liquid ammonia, chloride of ammonium, and hydrochloric acid were tried, but did not, for various and local reasons, answer the purpose. The author next tried chloride of calcium; this he found to answer as well with the soft residue of washing the ore schlich, containing only from 4 to 10 per cent of zinc, as with lumps containing from 20 to 27 per cent thereof; the result is that a nearly concentrated solution of chloride of calcium and boiling heat are required, but then the extraction is complete and far less expensive than with fuel, and the material obtained is readily reduced by the ordinary method of zinc smelting.

On Oxysulphobenzid.—Dr. L. Glutz has made a series of experiments which induce him to call phenol not an oxyhydrate, but an oxyhydrocarbon; this opinion is based upon the change which phenol undergoes when it is converted into oxysulphobenzid. This substance—

$$\left.\begin{matrix}C_{12}H_5O_2\\C_{12}H_5O_2\end{matrix}\right\}S_4O_4$$

is obtained when 1 equivalent of phenol is heated to 160° C. with 1½ equivalents of strong sulphuric acid, the mixture poured into water, wherewith the crystalline mass thus obtained is thoroughly washed it is next purified by dissolving it in ammonia, and precipitated from this solution by means of hydrochloric acid. The oxysulphobenzid is almost insoluble in cold water, readily soluble in alcohol and ether; it crystallises from its solution in boiling water, forming needle-like crystals; it is not affected by a high temperature, but it is difficultly sublimed; on being heated to redness it first melts, next burns off, leaving a difficultly-combustible coal. It is a weak acid, and readily soluble in the alkalies and their carbonates; it combines as well with acids, and very readily with nitric and acetic acids, but these compounds can only be formed indirectly. The author considers this substance to be an oxyaceton of the sulphuric acid series—that is to say, a derivative of a bibasic sulphuric acid, the extra radical oxygen atoms of which have been replaced by oxyphenyl.

On Mercury Naphthyl.—MM. Otto and Möries have instituted some researches on this compound, which was obtained by treating bromonaphthalin, boiling at between 277° and 278° C., with coal-tar oil boiling at from 120° to 140° C., with pasty sodium-amalgam; heat was applied, and the mixture brought to boiling and filtered while hot; on cooling, the filtrate deposited the mercury-naphthyl in small yellow crystals, which were purified by repeated re-crystallisation from solutions in benzol or sulphide of carbon. The mercury naphthyl—

$$\left.\begin{matrix}C_{10}H_7\\C_{10}H_7\end{matrix}\right\}Hg$$

exhibits small colourless prismatic crystals, not changed in the air or light, without smell, insoluble in water, sparingly soluble in alcohol, more readily soluble in warm benzol, sulphide of carbon, and best in chloroform; it fuses at 243° C., and is not quite volatile without becoming simultaneously decomposed. Heated with soda-lime, it yields mercury, naphthalin, and a hydrocarbon melting at 133° C.; the haloid hydrogen acids decompose it into naphthalin and the respective haloid salts of mercury. When moistened with alcohol, sulphuretted hydrogen does not affect it at all; fuming nitric acid converts it into nitrate of mercury and a nitro-substitute of naphthalin. Dissolved in sulphide of carbon it combines with iodine, forming biniodide of mercury-naphthyl.

Zeitschrift für Chemie, von Beilstein, No. 5, 1869.

This journal contains the following original articles:—

On the Decomposition of Grape Sugar in Alkaline Solution by Oxide of Copper.—It is well known that some years ago it was stated by Reichardt that gum and gummic acid ($C_6H_8O_{10}$) were the products of this reaction. M. A. Claus has endeavoured to control this statement by making a new series of researches on this subject; he reduced about 80 grms. of oxide of copper (equal to 36 grms. of sugar) at a temperature between 12° and 14° C., filtered the liquid, acidified it with acetic acid, and precipitated with acetate of lead; the precipitate thus obtained was carefully washed, next decomposed by means of sulphuretted hydrogen, the sulphide of lead removed by filtration, and the fluid somewhat evaporated at a temperature not exceeding 40° C. After removal of the HS, the fluid was divided into two equal portions, one of which was precipitated with chloride of calcium, the other with chloride of barium; the precipitates thus obtained were, after having been dried at 100° C., perfectly white, but not crystalline. The salts were analysed, and the result was, that not gummic acid, but oxymalonic acid, is formed; but this acid is no more the chief produce of this reaction than is gummic acid. The quantity of oxymalonic acid is only small; at the same time oxalic, formic, and acetic acids are generated. The quantity of oxymalonic acid obtained in free state was too small for full investigation of its properties.

Oxidation of Acetic into Oxalic Acid.—Dr. F. Lossen states that when one part of acetate of soda, one part of hydrate of soda, and two parts of permanganate of potassa are dissolved in a little water, the solution concentrated by boiling, and next brought to dryness at a temperature at which oxalic acid is not decomposed, and this heating continued until a small test-portion ceases to yield, with water, a green-coloured solution, oxalic acid can be readily proved to exist in the remaining saline mass.

On the Constituents of Peru Balsam.—M. Delafontaine has recently taken up this subject again for his experimental researches. He obtained a substance known as cinnamein, which, however, appears to be a mixture of cinnamic-benzyl ether and cinnamate of cinnamic ether; this cinnamein boils at 305° C., but is then, also, partly decomposed, leaving a resinous residue, while, when the operation is pushed rather rapidly, inflammable gases are also given off. In order to prevent any secondary decomposition, a portion of cinnamein which had not been submitted to any heat at all was saponified in the cold with an alcoholic solution of caustic potassa, and the result of this operation treated with water; this dissolved cinnamate of potassa and an oil was set free, which, by means of fractional distillation, was separated into benzyl alcohol (boiling at 205°) and cinnamic alcohol (boiling at 222°); this latter was colourless, very fluid, and the quantity obtained thereof was about half that which was obtained of benzyl alcohol. The results of the researches made by Plantamour on this subject about thirty years ago were the same. The chief mass of the balsam is therefore cinnamein, but it also contains variable quantities of other substances, among these toluol and some ethereal oils, not properly known in separate state.

On the Estimation of the Value of Indigo.—M. George Leuchs estimates the indigo-blue, the chief and only valuable constituent of the drug, in the following manner:—By means of 35 grms. of lime and 30 grms. of protosulphate of iron, 10 grms. of indigo are dissolved in 3 litres of water. In order to exclude the access of air, some petroleum was poured on the top of the fluid; (this fluid, however, was simply used as one to experiment with), and the experi-

ments lead to the result that equal portions of this solution reduce equal quantities of peroxide of iron, and that this reaction proceeds as expressed by—

$$C_{16}H_8NO_2 + Fe_2O_3 = 2FeO + C_{16}H_8NO_2 + HO.$$

In order to test any sample of indigo, 1·91 grms. thereof are so mixed with lime and sulphate of iron as to form a solution measuring 300 c.c., which should be placed in a tall cylindrical glass vessel provided with a well-fitting glass stopper. To 100 c.c. of the solution thus obtained, 66⅔ c.c. of a solution containing 1-10th of iron alum acidulated with sulphuric acid are added; the fluid so obtained is filtered, and 100 c.c. of the filtrate are taken and titrated with a solution containing 1-10th of bichromate of potassa, which is best run into the indigo containing fluid from a burette having divisions of ½ c.c., in which case every division is equal to 1 per cent of indigo-blue.

No. 6, 1869.

On Cyanphenylen.—M. W. Irelan states that, when bromophenylsulphate of potassa and cyanide of potassium are intimately mixed, and after having been placed in a glass retort submitted to destructive distillation, a white substance is sublimed at the neck of the retort. It is a compound expressed by the formula $C_8H_4N_2$; it is, in fact, cyanphenylen, a substance possessed of a pleasant aromatic odour, insoluble in warm, as well as in cold water, difficultly soluble in boiling alcohol, and pretty readily sublimed by application of heat. Boiled with strong caustic potassa, it evolves ammonia, and is changed into an acid which, by its properties and composition is terephthalic acid.

On Ethyldiphenol.—M. Burr states that when one atom of ethylen-bromide, and two atoms of finely-powdered phenolide of potassium, are heated together in a sealed tube at 140° C., bromide of potassium is formed, and an oily substance, which, on being first treated with water to separate it from the salt just alluded to, is readily soluble in ether, and, on the evaporation of that fluid having taken place, is left as a solid crystalline substance. Its formula is $C_{14}H_{14}O_2$; it is devoid of taste and smell, insoluble in water, soluble to some extent in alcohol, very readily and largely soluble in ether, fuses at 98·5° C., and becomes solid again at 92·5° C. On being heated on platinum foil it takes fire and burns off, giving a strongly sooty flame; on being heated with nitric acid, it is converted into a deep yellow mass of needle-like crystals, which is soluble in ether, and exhibits acid properties.

On Chlorethyl-sulphuric Acid from Chlorethyl-Chloride.—M. Kind has made some experiments with the view to ascertain whether the simply-chloruretted chloride of ethyl behaves with neutral sulphite of soda in a similar manner as ethylen chloride. Pure chloraretted chloride of ethyl, the boiling point of which was ascertained to remain constantly 63° C., was so mixed with sulphite of soda as to agree with two atoms of the latter substance against one of the former; the mixture was heated in a sealed tube for twenty-four hours consecutively at a temperature of 140° C. On opening the tube it was found that all the oily fluid had disappeared. The saline mass was first treated with dilute sulphuric acid until chlorine could not be any more detected by means of nitrate of silver, next neutralised with carbonate of soda, and, after having been evaporated to dryness, treated with alcohol; the therein soluble salt proved, on analysis, to have the exact composition of chlorethyl-sulphate of soda.

On the Synthesis of Hydrocinnamic Acid.—The formation of hydrocinnamic acid from cinnamic acid, and the fact first observed by Erlenmeyer, that the first-named acid is converted into benzoic acid on becoming oxidised, authorise the opinion that the constitutional formula of hydrocinnamic acid is—

$$C_6H_6 + CH_2 - CH_2 - COHO.$$

M. R. Fittig has found this to be a correct view, by discovering a new synthetical method of preparation of the hydrocinnamic acid from phenylethylchloride, a colourless liquid which boils at about 200° C. This substance was first converted into a cyanide, by means of treating the same with cyanide of potassium and alcohol; this cyanide was decomposed with caustic potassa, the residue first acidified with sulphuric acid, next shaken up with ether. On removing the ether by distillation a yellow coloured acid fluid was left, which, on being repeatedly treated with cold water, became solid; a calcium salt of this acid was made, and found to be readily soluble in hot water, from which solution it crystallised in colourless silky-looking needle-shaped crystals. On being submitted to elementary organic analysis, this calcium salt, after having been first thoroughly dried over sulphuric acid, was found to yield results corresponding to the formula—

$$(C_9H_9O_2)_2Ca + 1\tfrac{1}{2}H_2O,$$

which is identical with the formula derived by M. Erlenmeyer, from his researches on hydrocinnamic acid obtained from cinnamic acid.

On the Identity of Dichlorbenzoic and Paradichlorbenzoic Acid.—Dichlorbenzoic acid is readily prepared by boiling benzoic acid with a solution of hypochlorite of lime; the crude dichlorbenzoic acid obtained is combined with baryta, and the resulting salt purified by repeated crystallisation. The acid crystallises from its aqueous solution in needle-shaped crystals, fuses at 201 C., and sublimes without decomposition. The barium salt—

$$Ba(C_7H_4Cl_2O_2)_2 + 4H_2O,$$

crystallises in small needle-like crystals; the calcium salt—

$$Ca(C_7H_4Cl_2O_2)_2 + 3H_2O,$$

also appears to crystallise, and is more readily soluble in water than the baryta salt. From what has been communicated, it is clear that dichlorbenzoic and paradichlorbenzoic acid are one and the same substance.

On the Preparation of Methyl-naphthalin.—Methyl-naphthalin is prepared, according to Stacewicz, by heating together a mixture of a sulpho-salt of naphthalin, acetate of lime, and quick-lime. The distillate is dissolved in alcohol, and to the concentrated solution thus obtained water is gradually added; the substance thus separated is again dissolved in alcohol. After the evaporation of that menstruum a crystalline solid is obtained, somewhat yellow-coloured, smelling like turpentine; it is sparingly soluble in alcohol, more readily in ether; is soluble in strong sulphuric acid, yielding to it a pink colour. Its specific gravity is about 1·0; it melts at 69° C.; formula, $C_{11}H_{10}$; percentage composition, C, 93·0; H, 7·0.

On Perchloride of Benzol and its Formation from Toluol and Xylol.—MM. Beilstein and Kuhlberg have instituted a series of researches in order to prove that heptachlortoluol is nothing else than perchloride of benzol. The former substance has its formula C_7HCl_7, and its composition in 100 parts is expressed by—C, 25·2; Cl, 74·5; H, 0·3. The latter substance is expressed by the formula C_6Cl_6, and in 100 parts it contains—C, 25·3; Cl, 74·7. Elementary analysis could not decide anything in this instance, but the authors having followed Hugo Müller's method for the preparation of perchloride of benzol, and by diligently making a comparative study of the melting points, boiling points, and degrees of solubility, found that these properties so perfectly agreed that they feel confident both substances are identical.

On some new Compounds Derived from Mesitylen.—MM. Fittig and Hoogewerff have made a series of researches on this subject. Chlorine, it appears, acts most violently on mesitylen even when kept cold, so that the authors found great difficulty in managing the effects of this gas. They obtained monochlormesitylen, $C_6H_2Cl(CH_3)_3$, a colourless fluid as limpid as water, which boils, without undergoing decomposition, at between 204° and 206° C.; it is readily soluble in alcohol. Dichlormesitylen, $C_6HCl_2(CH_3)_3$, is a solid; it crystallises from alcohol, forming beautifully shining prisms, fuses at 59° C., boils without decomposition at 243°, is readily soluble in warm alcohol, and, in the cold, in ether and benzol. Trichlormesitylen, $C_6Cl_3(CH_3)_3$; this substance is also a solid, and obtained when mesitylen, kept very cold, is treated with an excess of chlorine gas; it crystallises from boiling alcohol, yielding long colourless needle-shaped crystals, not very soluble in cold alcohol, better in ether; fusing, without decomposition, at 204°; sublimable, also, without decomposition, at a higher temperature. The authors have studied and extended their researches over a series of very complex compounds obtained by the action of nitric acid upon the monochlormesitylen, and also over the derivatives from sulphomesitylenate of potassium; but, for particulars about these compounds, we beg to refer our readers to the original paper, since the authors have so concisely exposed these researches, that it is quite impossible, in justice to them and the subject, to abstract these matters.

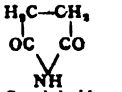
On the Specific Gravity of Chlorine.—M. E. Ludwig observes that, as a consequence of a series of determinations of the specific gravity of chlorine gas, the conclusion must be come to that this gas belongs to those kinds of vapours which only obey Mariott's law when it is at a temperature rather remote from that at which it is condensed to the fluid state. The specific gravity of chlorine at 20° C. is 2·4807; at 50° C., 2·4783; at 100°, 2·4685; at 150°, 2·4609; at 200°, 2·4502. According to experiments made by Stas, the specific gravity of chlorine, deduced from its atomic weight, is 2·45012. M. Ludwig has repeated experiments on this subject, and found the figures obtained and just quoted to be substantially correct.

On Allyl Alcohol.—M. B. Tollens writes to the editor as follows:—I find that allyl alcohol combines, although very slowly, with H_2, and no isopropyl alcohol is formed. When allyl alcohol is left for a considerable time in contact with a large excess of either sodium amalgam or zinc and dilute hydrochloric acid, some normal propyl alcohol is formed. When chlorine is made to act upon an aqueous solution of allyl alcohol, among other products I obtain a fluid boiling between 180° to 184°, and having its composition expressed by the formula $C_3H_6Cl_2O$; when this fluid is again treated with sodium amalgam, an alcohol is obtained. When this chloride, which happens to have the same composition as dichlorhydrin, is submitted to fractional distillation, I obtained one fluid which had its permanent boiling point at between 171° and 185° C.; the greater portion of the liquid distilled over at between 173° and 177°, a portion, however, also, at between 180° and 185° C.; the latter portion appears to contain the product derived from the action of chlorine upon allyl alcohol. Genuine dichlorhydrin boils at between 174° and 176° C.

On the Products of the Destructive Distillation of Glycolic and Lactic Acids.—M. A. Krupsky records some experiments made by him on the products which glycolic acid yields when submitted to destructive distillation. 35 grms. of this acid were gradually heated, first to 120°, next to 160°, and at last to from 200° to 220° C., the retort being placed for several days in a metallic bath made of an alloy of 2 and 1-16th parts of lead and 3½ parts of tin, which alloy melts at 175° C. In the neck of the retort a solid substance sublimed, which could only be removed by breaking the neck of the same; on being removed, the substance was triturated in a mortar, first washed with alcohol, next with water. After repeated purifying, it was submitted to elementary analysis, and the result was—Carbon, 39·34; hydrogen, 6·69; the substance, therefore, is dioxymethylen. When lactic acid is exposed to a higher temperature, even below 200°, M. Krupsky found it to yield lactide; the most suitable temperature for the formation of this substance is between 210° to 215° C. Lactide is a solid, and exhibits beautifully-rhombic crystals when its alcoholic solution is left to spontaneous evaporation. The author's advice to those who might desire to make this substance from lactic acid, is to take 100 grms. of the acid, to place it in a glass retort, heat first for eight or ten hours in a glycerine bath at from 100° to 110° C.; next

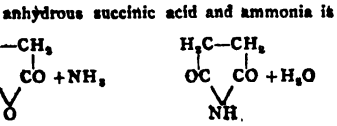
the temperature is for thirty hours kept at from 135° to 140° C. again the tempefature is raised to 170°, and at last kept at from 210° to 215° C. for about forty hours; by this method, about 20 per cent of lactide is obtained from the quantity of lactic acid originally placed in the retort.

On the Melting Point and Relative Constitution of Succinimide.—M. Erlenmeyer observes, that when he made experiments on succinic acid and succinimide, the composition of which latter substance agreed entirely with the results obtained by Fehling, he was astonished to find that the melting of succinimide was not 210° C., as stated by some authors, but 125°. M. Teuchert having, in his essay on succinamic acid, repeated the statement about the melting point of succinimide at 210° C., M. Erlenmeyer has thought it his duty to review his work and repeat his former experiments, and, moreover, obtained from M. Fehling a quantity of pure succinimide; the melting point was again found to be 125° C. As to the constitution of this substance, I prefer to express it, says the author, by a formula written in the following manner:—



Succinimide.

Its origin from anhydrous succinic acid and ammonia is thus expressed:—



NOTES AND QUERIES.

Cryolite.—We should be glad to know of a firm who are sellers of cryolite or Greenland spar.—J. B. and Co.

Sulphate of Manganese.—What is the annual consumption of sulphate of manganese, its price per ton, and what it is principally used for, and who are the principal buyers of it?—Wm. Blench.

Bread for Diabetes.—Can any of your courteous readers supply me with information respecting the manufacture of the bread which is prescribed in the treatment of diabetes?—Farina.

Alizarine.—Is MM. Graebe and Liebermann's discovery (the artificial preparation of alizarine) likely to be of any commercial value? Madder alizarine of commerce being extracted and sold profitably at less than £10 per cwt.—B. S.

Soldering Without Fire.—Information wanted concerning the brazing or hard soldering of copper without fire, and merely by the application of a preparation made for the purpose, quite independent of any galvanic arrangement.—Fluorine.

Carbonic Acid.—Referring to the query of Mr. E. Kernan in your number of April 30th, and referred to by Dr. A. in that of May 7th, may I venture to suggest that native carbonate of barium would be a more economical source of carbonic acid than the substance named? When treated with muriatic acid, chloride of barium is formed, and the carbonic acid gas is given off very freely. If sulphuric acid be added to the barytic salt which is in solution, sulphate of barium will, of course, be precipitated, and pure hydrochloric acid recovered. The price of the carbonate of barium is 7s. per cwt.—Frede. Braby.

On the Characteristic Differences and Tests for the Detection of some Fatty Oils.—Dr. Sacc, of Neufchâtel.—*Castor Oil.* Nearly colourless, very viscous, faint odour; becomes more fluid on being heated; becomes bright orange coloured in contact with nitric acid. The oil does not develope much heat when brought into contact with sulphuric acid; its colour becomes thereby cinnamon-brown. When the mixture is put into water it forms a mass at first insoluble, which, however, becomes gradually decomposed, the oil floating on the top evidently having undergone little or no change at all. Acetic acid does not act upon the oil at all; soda forms an emulsion to some extent with the oil, but fails to effect this completely; alcohol dissolves some of the oil. With solution of nut-galls, a portion of the oil is converted into an emulsion; liquid ammonia is without action; with nitrate of silver a yellow colouration appears at the point of contact; chloride of gold gives rise to the formation of an emulsion, and is itself partly reduced to metal. *Linseed Oil (Raw).*—Colour deep yellow; odour acrid; when heated, its colour becomes more pale, and the oil foams strongly; with nitric acid, olive-coloured tinge. Concentrated sulphuric acid causes much disengagement of heat, and the colour of the oil becomes dark brown; the mixture swells considerably; sulphurous acid is developed as well as formic acid. The residue is insoluble in water, and gives off the smell of asphalt; acetic acid, no action; with caustic soda solution, yellow emulsion; to a small extent soluble in alcohol. With solution of nut-galls the oil becomes solidified, forming a solid yellow-coloured mass; liquid ammonia causes it to form an emulsion. No action with nitrate of silver; chloride of gold is readily and completely reduced to the metallic state when in contact with this oil. *Poppy-Seed Oil.*—Colour bright yellow; no perceptible smell; no change on being heated; no action with nitric acid. With sulphuric acid very little heat is developed, and the oil is changed into a cinnamon-brown coloured magma insoluble in water. Becomes slightly turbid with acetic acid; forms a white emulsion with soda; not soluble in alcohol, which latter fluid floats on the oil; becomes slightly turbid with solution of nut-galls; forms a white emulsion with liquid ammonia. With solution of nitrate of silver a white emulsion is produced, only, however, at the point of contact between the oil and the solution; with chloride of gold a trace of reduction to the metallic state takes place. From these experiments we learn—(1) that nitric acid only produces a colour with ground-nut, cotton-seed, sesame-seed, castor, linseed, nut, and whale oils; (2) that sulphuric acid combines with all the oils, thereby producing compounds soluble in water in the case of olive, colza, ground-nut, cotton-seed, and sesame-seed oils; (3) that the solution of nut-galls is without action upon olive, nut, and whale oils, that all the others are made into emulsions, and that linseed oil is coagulated by the said solution; (4) that caustic soda solution forms emulsions with all the oils except that of cotton-seed, the castor oil, and nut oil; (5) that nitrate of silver becomes blackened only when in contact with colza oil; (6) that chloride of gold forms emulsions with all the oils and is in contact with all reduced to metal, excepting in the case of olive and colza oils; with the former of these and the reagent alluded to, no reaction takes place at all, and with the latter an emulsion is only formed, no reduction taking place.—*Rev. Hebd. d. Chim.*, No. 23, 1869.

MEETINGS FOR THE WEEK.

Tuesday, 25th.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."
Wednesday, 26th.—Society of Arts, 8.
—— Geological, 8.
Thursday, 27th.—Royal Institution, 3. Professor Tyndall, "On Light."
—— Royal, 8.30.
—— Zoological, 8.30.
Friday, 28th.—Royal Institution, 8. Mr. Lockyer, "On Recent Discoveries in Solar Physics."
Saturday, 29th.—Royal Institution, 3. Mr. Deutsch, "On Semitic Culture."

TO CORRESPONDENTS.

*** We shall feel indebted to correspondents who will forward us Reports of Local Meetings of Societies, Chemical Appointments, and any other subjects interesting to the chemical world. We regret that, owing to the increasing popularity and circulation of the Chemical News, and consequent pressure on our space, we are often obliged to delay the publication of long papers. To those correspondents who wish to favour our readers with Notes of New Discoveries, Descriptions of Apparatus, or Answers to Questions, we would especially recommend our Notes and Queries columns.

Erratum.—Page 232, column 1, line 2 from top, for "sea" read "Lea."

B.—The question was answered in our last number.

E. K.—We know of no sources of experiments on the aniline dyes than the lectures which have, from time to time, appeared on the subject in our pages.

Communications have been received from J. A. R. Newlands; W. F. K. Stock; J. Bayne; W. Blench; C. G. Williams, F.R.S.; Mor Thomas; R. G. Bennett; F. Braby; S. D. Tillman; W. C. Roberts; J. Bethell; C. W. Heaton; Dr. R. Angus Smith, F.R.S.; E. Kernan; T. A. Orme; M. A. Baines; W. H. Perkin, F.R.S.; J. H. Cheshire; W. A. Murray; D. Brown; J. Kempster; C. S. Woodrowe; T. Hueks; E. H. Moss; S. Mellor; W. Baxter; T. A. Pooley; F. Stevenson; J. Yates; W. Wyles; J. Millar; Green and Co.; Eichholz and Co.; Todd and Son; Calvert and Co. (with enclosure); G. A. Keyworth; E. Meldrum; E. K. Muspratt; A. Warner; W. Huggon; B. Winslow; and White and Co.

Just published, demy 8vo., price 6d.

On English and Foreign Alkalimetrical and Chlorimetrical Degrees, by John Pattinson, F.C.S. Read before the Newcastle Chemical Society.

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THE CHEMICAL NEWS.

VOL. XIX. No. 495.

ON A METHOD OF MAKING

RAPID DETERMINATIONS OF FREE OXYGEN.

By P. HART.

THE apparatus required consists, in addition to an ordinary pneumatic trough, of two tubes each half-inch diameter and 16 inches long, closed at one end. One of the tubes is graduated into 50ths of a cubic inch, and the other is coated internally with phosphorus. This is effected by dropping into the tube a few pieces of phosphorus; it is then to be closed by a sound cork, and the phosphorus (melted by immersing the tube in hot water) may be spread in a thin coating over the interior by turning it round as it cools. On cooling, the cork is to be withdrawn, the tube filled with water, and a piece of india-rubber tube tied securely over the mouth. This completes the apparatus.

Modus Operandi.—Both tubes are filled with water and allowed to remain in the trough, a portion of the air to be examined is passed into the measuring tube, which is now allowed to remain for five minutes in the trough to allow it to attain the same temperature as the water. It is lifted until the water is at the same level within and without, and may then be closed by the finger, and withdrawn from the trough. The volume is easily noted. This done, it is connected by the india-rubber joint with the phosphorus tube, into which the air is allowed to flow. The whole may now be placed for half an hour in the trough, when the gas may be poured back into the measuring tube, the level once more taken, and the volume read off in the same way as before. The loss is oxygen.

a *b* *c*

a. Measuring tube.
b. India-rubber junction.
c. Phosphorus tube.

No claim is made for strict scientific accuracy in connection with this apparatus; its sole merit consists in its offering an easy and rapid means of approximately determining the free oxygen in an atmosphere. In the working of sulphuric acid chambers it has been found extremely valuable, and possibly may be found so for other technical enquiries.

REMARKS ON THE

ESTIMATION OF COPPER IN ORES.

By FREDERICK FIELD, F.R.SS. L. and E.

THERE is a detailed account in the CHEMICAL NEWS (Nos. 489 and 491) of certain methods for the estimation of copper in ores, for which a premium has been awarded. The paper also contains some valuable observations by Dr. Steinbeck on the volumetric determination of copper by means of cyanide of potassium, known generally in England as Parkes's method. Dr. Steinbeck gives us the results of his experiments, which prove that, in order to estimate the metal correctly, care must be taken to avoid great excess of ammonia, or its salts, as these exercise a very disturbing influence. The Dr. has also paid considerable attention to the influence which other metals exert when in combination with the copper, and finds that lead does not interfere in any way with the valuation of the former. He recommends the thorough washing away of the salts of zinc from the precipitated copper, previous to its solution in nitric acid, as the presence of that metal would greatly interfere in the estimation of the copper.

The writer is able most fully to confirm the above statements, from the lengthened experience he has had in South America in the estimation of copper in ores, slags, &c., many thousands of assays having been performed by Parkes's method; but there are other metals, not mentioned in Dr. Steinbeck's report, which frequently occur associated with copper, and would also be precipitated upon the zinc, together with that metal. Arsenic is, perhaps, the one most generally found; and, from many careful experiments, it has been satisfactorily proved that it exerts no influence whatever upon the correctness of the method. The same may be said of both tin and antimony.

It can be easily imagined that the metals whose oxides are soluble in ammonia would interfere with the amount of alkaline cyanide necessary to remove the colour from an ammoniacal solution of a known weight of pure copper, seeing that a portion of the cyanogen is devoted to the other metals, as well as to the copper itself. This is, of course, the case with silver, zinc, nickel, and cobalt; the two first metals forming double cupro-cyanides of great beauty and interest; and it can also be well understood that *more* cyanide is required in these instances than with copper *per se*.

But the writer has shown (CHEMICAL NEWS, vol. i., p. 26) that, in the case of manganese, the result is entirely different, the solution of the two metals requiring *less* cyanide than copper would for its decolourisation. For instance, 10 grains of electrotype copper were brought into solution with 20 grains of sulphate of manganese, and a known weight of ammonia and chloride of ammonium added. The cyanide of potassium contained in 85 divisions of the burette was found sufficient* to decolourise the liquid; while 100 divisions were requisite for ten grains of copper without manganese, treated under precisely similar circumstances.

The writer would be very glad if some one of the numerous readers of the CHEMICAL NEWS would explain this fact, which he confesses appears to him somewhat difficult.

A CHEMIST'S VIEW OF THE SEWAGE QUESTION.†

By EDWARD C. C. STANFORD, F.C.S.

OUR great object is to consider, first, how to carry away from our houses the excreta of our large population; and secondly, how to treat it so as to recover for our use its full fertilising value. The peculiar character of the material to be dealt with renders some vehicle necessary for its transport.

This vehicle may be either solid, liquid, or gaseous; and the secondary proposition depends so entirely upon the vehicle employed for the first, that I intend briefly to review these three several means of conveyance in their chemical aspect. To avoid complication in speaking of either, I shall assume the general adoption of solid vehicles, the cheapest being earth, of liquids water, and of gases air; I shall speak of the three different methods as water, earth, and air carriage, taking water first, as being now most common.

I wish to premise, however, that I regard both the above

* On the addition of Liebig's cyanide of potassium to an ammoniacal solution of the oxides of manganese and copper, a certain portion of the former is precipitated. It might be imagined that this precipitate dragged a portion of the copper with it out of solution; this is, however, not the case; the precipitates in many instances having been carefully examined for that metal.

† Read before the Glasgow Sewage Association, March 30th, 1869

propositions as essential and necessary; and take as my text Mr. F. O. Ward's celebrated formula—"the rainfall to the river, and the sewage to the soil,"—no system of sewerage is worthy our consideration which does not give back to the soil that which in our food we have taken from it; and I consider the mere ridding ourselves of a valuable fertiliser, simply on account of difficulty in dealing with it, quite beneath the enlightened spirit of our age.

For convenience of calculation, I take the population of Glasgow at 500,000, and the value of the excreta at 8s. 4d. per head per annum, or £208,333. This is the value given by Professor Way and Mr. Lawes (the highest authorities on this subject), in the third report of the Sewage Commission, and it is now generally adopted by all chemists, each person being reckoned as contributing the value of 12½ lbs. of ammonia per annum.

The total bulk of excreta, making allowance for loss, is estimated at 10 cubic feet per head per annum, and its weight 630 lbs., making an annual total of 5.000,000 cubic feet, weighing 140,625 tons; or, per day, 13,698 cubic feet, or 385 tons.

This, then, is what Glasgow has to remove. The value is 10d. per cubic foot, or 29s. 6d. per ton, and equal (Professor Way) to 16,666 tons of Peruvian guano annually. Of this amount the solids form 1-10th, and the liquids 9-10ths; or 1 cubic foot per head per annum solid, and 9 cubic feet of liquid. The solid and liquid excreta have a relative chemical value of 1 to 6, or 1s. 2d. per head for the former, and 7s. 2d. per head for the latter. The total is thus divided:—

	Tons.	s. d.	£
Annual value of solid excreta..	14,062 at	41 5 ..	29,161
,, ,, liquid ,, ..	126,563 ,,	28 3 ..	179,172
			£208,333
The value of the daily removal is	385 ,,	29 6 ..	£569

Let us now see how this is proposed to be removed, and what is to be gained in the process.

Water Carriage.

Taking the amount of water used per head at 5 cubic feet daily, and the rainfall the same, we have the 10 cubic feet diluted with 3650 of water, and the annual material to be removed increased from 500,000,000 cubic feet to 1,825,000,000 cubic feet, or 140,625 tons increased to 50,920,401 tons; in other words, we require daily to pump away 140,000 tons of sewage to remove 385 tons of excreta, of which only 38½ tons is solid matter. No wonder we are called upon for lavish expenditure to carry off such a quantity as this, for even if no pumping were required, the cost for sewers must be enormous. And then does it carry it away?—and does it utilise it? Suppose an elaborate system of intercepting sewers to convey our sewage to some point several miles down the river; would that meet the evil? Let the experience of London answer this. The metropolitan sewage works are the greatest effort of this kind, and, from the difficulties overcome, are a perfect triumph of our engineering skill, reflecting the highest honour on Mr. Bazalgette; but they cost the princely sum of £4,250,000, or £180,262 per annum, the cost to be paid off in forty years by rating, at the end of which period the Thames will probably be closed as a port by their deposit, the sewer gases will have proved themselves the most deadly of enemies, and London will stand on a substratum of soil loaded with sewage from infiltration and leakage.

To show that these are not improbable speculations, I append an extract from an able article in the *Pall Mall Gazette* of February 26th, 1868, entitled "The Sanitary Dead-Lock":—

"It has now been decided that although Parliament has conferred the right of drainage into the sea and public rivers, this right can only be exercised subject to the condition that no other nuisance is thereby created. 'The notion of collecting all the sewage of a large town,' says Vice-Chancellor Wood, in the case of Blackburn, 'and pouring it into a river without the slightest attempt to clear it of any of its grossest materials, is simply monstrous.' And, again, in the Attorney-General *v.* Birmingham Town Council, the court went as far as to declare that it would not balance the convenience of a town against the legal rights of an individual complainant—the latter must be respected. . . . . The case of the metropolis differs from that of the provincial towns, but has occasioned a similar sanitary dead-lock. The main-drainage system discharges the refuse of London into the Thames at Barking and Crossness, comparatively out of the way of population. Although there is, therefore, no sanitary objection to these works, except as regards the towns below London, such as Barking, North Woolwich, Woolwich, Greenwich, Erith, &c., a serious difficulty of another kind has arisen. The mass of matter daily washed down by the sewers of London is so great that, during the few years that have elapsed since the opening of the new sewers, an enormous concentrated deposit of mud, street sweepings, and sewage refuse has accumulated in the bed of the river at Barking and Crossness, and now obstructs the navigation of the river. Last November Mr. Cave stated in the House of Commons that a ship had already stranded on one of the banks thus formed. A chart of the bed of the river at Barking, which has recently been prepared, shows that in the very centre of the channel the soundings have diminished at low water from 21 to 10 feet. . . . Whatever may be the legal aspect of the question, it is quite evident that the navigation of the Thames cannot be allowed to be obstructed even for the sake of draining the metropolis, and that legislative interference will be required if the existing Acts are at all doubtful on this point. Indeed, the whole subject demands the careful consideration of Parliament, in order to release the municipal authorities throughout England from the embarassing position in which they are now placed. Some way must be discovered of draining our towns at a less sacrifice than is involved in the pollution of streams and blocking up of navigable rivers."

And as to the sewer gases, it appears, according to the evidence collected by the sewage commission, quite impossible to get rid of them; one of the engineers examined making this terribly suggestive answer:—"I am afraid we must let out the stink in the middle of the streets."

Now stink is not the word, for sewer gases are gases of decomposition, and carry malaria, pestilence, and death with them. Dr. Fergus has related one of many instances in which a number of houses at Leith, previously healthy, have been affected at once with gastric (or typhoid) fever, when connected with the sewers; and showing the constant infiltration of sewage into the soil, and thence into wells; he has also pointed out cases of gastric fever where the long unsuspected cause was the drinking of the water so contaminated.

Mr. Bazalgette states, that to ventilate the London sewers by air would cost £460,000 in plant, and £201,480 annually for fuel alone, exclusive of labour and other expenses; he also states that to flush them with water would cost £383,250 annually, even if the water-works could supply the quantity, which is out of the question. The water-closet system is also open to great objection—the best constructed closet is seldom perfectly free from odour; the back rush of deadly gases up the sewers when a high tide covers them, or a strong gale blows into their outlets at low tide, is of enormous force, and will rise through any closet, however well trapped.

Water is a mere carrier, and no disinfectant; its cost, also, from the great quantity required, is very considerable. Mr. Smith has stated the cost here at £40,000 per annum, and, no doubt, if general, £50,000 at least would be required to provide the water and keep up the closets.

The whole system of sewerage by water carriage is recklessly extravagant; it carries the solid and liquid excreta down to our neighbours to rot at their doors, and

it leaves us a legacy of deadly gases to remind us that our endeavour to cheat nature has signally failed. As applied to even ridding ourselves of the nuisance, it is the finest effort of "the circumlocution office," and the best illustration of "how not to do it," in our generation.

Engineers have employed an elephant to do the work of a mouse, and the burly brute has trodden down and has laid waste the country.

Then, as to its utilisation; here the system almost entirely breaks down. Notwithstanding numerous attempts, no portable manure ever has been, or ever will be, made out of sewage. The chemical value of average sewage, if it could be extracted, is 1d. per ton, taken at 4 grains ammonia to the gallon; this value is deduced from 93 analyses of Rugby sewage by Professor Way, and now generally admitted. One thousand tons are equal to 12 cwts. Peruvian guano.

Much has been said here about the solid matter deposited from sewage by standing; let it be clearly understood that it is almost valueless. At Birmingham it accumulates in large quantity, and cannot be sold at 6d. per ton. The reason of this is obvious; almost the entire manurial constituents are soluble in water; and no wonder all companies looking amongst the deposit for their dividends have failed to find them. They are exactly in the position of a ferret, watching patiently one end of a rat hole while the rat has escaped by the other.

The report of the sewage commission gives abundant evidence that even sewage irrigation only pays in certain favourable circumstances. This report is full of information, and represents an enormous amount of labour by its learned authors. They have worked hard to pick out the grain of wheat from the sack of chaff; but we must all admit that it would have saved them much trouble if we had never allowed the admixture.

Irrigation, the only method of utilising sewage, puts an amount of money value on the ground out of all proportion to the return obtained by the ratepayers. There appears no doubt that the farmer will not give ½d. per ton for it, delivered free of expense. Where gravitation and open carriers can be employed without pumping, its application is remunerative; but in no case is anything like the full money value obtained to the ratepayer. The cost of transport, where the chemical value of a product is only 1d. per ton, is far the more important item.

According to Professor Way's estimate, Glasgow would require 10,000 acres, constantly in use, at 5,000 tons sewage per acre per annum, and it would really require 15,000 acres, as one-third must be under root crop.

Now, in a damp climate like ours, what land would take this extra amount of water? and what farmer would ever dream of top-dressing his grass with manure equal to 3 tons of Peruvian guano per acre, if he had to pay the full market value for the manure? Moreover, what could be done with the grass where, as in our case, it would be impossible to make it into hay?

This system of sewage by water carriage is, however, now so general, that any means of modifying its evils may be worth our notice.

The sewer traps should all be provided with sieves of charcoal; and I propose to avoid the unsuspected dangers of the sewer gases rising in our present water-closets, to employ a double sieve of wire gauze, containing charcoal, which will slide in just under the seat, and completely close the opening, and which, by a little mechanism, can be made to slide back automatically. Or to enclose the charcoal in a small box with wire gauze sides, and simply place it in the closet. I employ, by preference, seaweed charcoal, the use of which I propose also for the filtration of town sewage, before it is allowed to pass into rivers. It is singularly allied to animal charcoal, which it excels in its porosity, its high oxidising power, and in the ease with which it admits the rapid passage of thick liquids. The thickest sewage passes through perfectly odourless and colourless. It entirely removes the organic matter from ordinary sewage, and can be used for a considerable length of time, without change. To gain its full power, the sewage should be run into large tanks, which can be used alternately: it is here allowed to deposit for 24 hours. The filtration should be upwards, through a stratum of char, and, when the deposit rises to the char, the whole should be mixed together, and made into manure; the char mixed with the sludge would render it more easy of transport. I do not intend to imply that the char removes the manurial value of the sewage to any great extent, but it renders it innocuous.

(To be continued.)

ON SOME APPLICATIONS OF ELECTRICITY TO NAVAL AND MILITARY PURPOSES.*

By F. A. ABEL, F.R.S., For. Sec. C.S.

(Concluded from p. 243).

There are two distinct systems of applying electricity to the explosion of torpedoes. The most simple is that in which the explosion of a torpedo is made dependent upon the completion of the electric circuit by operators stationed at one or more posts of observation on shore. The particular mode of arrangement and the operation to be adopted depend in great measure upon the nature of the locality to be defended by torpedoes. If this be a river or channel, the plan of arranging and exploding torpedoes is comparatively simple, but will serve sufficiently to illustrate the general nature of this system of applying torpedoes. The mines are arranged across the river or channel in rows or lines, converging towards a station on shore, to which the conducting wires are led which are to connect each torpedo with the exploding instrument. The operator at this station has it in his power, therefore, to explode any one of the torpedoes at will, by completion of the circuit through the particular cable and the earth. Some other position on shore is selected as a second station, which commands points of view intersecting the lines of torpedoes. The operators at the two stations are placed in telegraphic communication with each other, and when a ship is observed by the operator at the second station to approach the direction of any one of the torpedoes, he will signal to the man who looks along this line of torpedoes, and the latter will complete circuit as soon as the vessel appears over the particular torpedo specified. Should the vessel alter her course in approaching the torpedoes, the operator at the observing station will inform the man at the firing station, who will alter his arrangements accordingly. Or, the man at the observing station, when he perceives a vessel to approach in a line with any of the torpedoes, places the cable of that torpedo in electric connection with the operator at the other station, and the latter will complete the circuit through the earth to the torpedo as soon as he sees that the vessel is over the first line of torpedoes. Other more or less elaborate modifications of these modes of observing and exploding have been proposed; they all depend for efficiency upon the experience, harmonious action, and constant vigilance of the operators at the exploding and observing stations. They are, moreover, entirely useless at night, and in any but clear weather. They are therefore not to be compared, in general efficiency, with self-acting electric torpedoes, which are either exploded by their collison with a ship, whereby electric circuit is completed within them, or by the vessel striking a circuit-closing arrangement moored near the surface of the water, whereupon either the torpedo, moored at some depth beneath, is instantly exploded, or a signal is furnished at the station on shore, which indicates to an operator the particular torpedo to be exploded. The object to be attained in these circuit-closing apparatus, which are so moored as to be within range of a passing

ship, is to oppose in the path of a vessel a contrivance which will not be affected by the motion of the water, but which will complete electric circuit between the conducting cable and the fuse, if struck in some particular part, or thrown into a particular position, by the advancing ship. Numerous ingenious contrivances have been proposed for this purpose and experimented with, but in only two or three instances have satisfactory results been attained, the conditions essential to success being numerous, and their combined fulfilment not easy of attainment. Simplicity of mechanism and a combination of sufficient, but not excessive, delicacy of action, with permanence during long immersion, are among the most important objects to be aimed at in the construction of these circuit-closing or signalling machines or self-acting torpedoes, which, if efficient, must contribute most importantly to the success of any arrangements for defence of a water by electric torpedoes.

It has been shown that magneto-electric instruments cannot be relied upon for submarine operations, on account of the perfect insulation of the conducting wires, joints, &c., required to ensure success with machines of that class. On the other hand, frictional machines and also dynamo-electric machines leave little to be desired as regards power to effect even the simultaneous ignition of numerous submarine mines, through cables in the insulation of which, from long-continued use, some defects exist. These instruments, therefore, are available as most efficient instruments when any extensive submarine operations have to be accomplished; but the frictional machines cannot be used as the exploding agents in connection with any system of defence by torpedoes which depends for its efficiency upon the explosion at the proper moment of only the particular torpedo over which a vessel passes, while all surrounding torpedoes still remain intact; because, for the reason which has been given, the explosion of the proper torpedo will almost invariably be attended by the accidental explosion of others which it is not desired to bring into operation. The same objection applies, at any rate to some extent, to the dynamo-electric machines. These two classes of instruments are therefore only susceptible of certain special applications in connection with submarine mines. There is, moreover, another general objection to the use of any source of electricity, the action of which is entirely dependent upon an operation to be performed at the instant that an electric discharge is required. This consists in the fact that, although the torpedoes may be self-acting, their efficiency is still dependent upon the vigilance and presence of mind of an operator on shore.

The only sources of electricity which thoroughly fulfil the conditions essential to its application with perfect confidence in connection with self-acting torpedoes, are constant voltaic batteries. By substitution of the Abel fuse for the old platinum-wire fuse, it has become possible to use batteries which were previously inapplicable to the explosion of mines, because, even when employed in considerable numbers, the quantity of electricity furnished by them is not sufficient to effect the ignition of platinum wire. Thus, a number of elements of a Daniell's battery or a sand battery, quite incapable of heating a platinum wire to redness, fires an Abel fuse with perfect certainty. The heat developed in the latter by the passage of a current from such a battery amply suffices to raised to its igniting point the readily explosive priming mixture which serves as the conductor in the fuse. Moreover, the resistance presented by the fuse is so considerable in comparison with that offered by the longest cables which are likely to be used in actual practice, that a current from a battery which possesses tension sufficient to overcome the resistance of the fuse will explode the latter with as much certainty, through cables of great length, as when it is close to the battery. A number of cells of a Bunsen's battery, sufficient to ignite a piece of platinum wire several inches in length, when close to the battery, the current of which possesses also sufficient tension to ignite an Abel fuse, will be incapable of rendering a very short piece of thin platinum wire even moderately warm, if four or five hundred yards of ordinary conducting wire be introduced into circuit; but its power of exploding an Abel fuse will not have become at all affected. It is evident from this illustration that the necessity for greatly adding to battery-power, when mines are to be exploded through considerable lengths of wires, which exists with the use of the wire-fuses, is obviated by employing the new fuse; and thus one great objection to voltaic batteries, as exploding agents in mining operations, is set aside. Again, the sand batteries, or Daniell batteries, which are used for telegraphic purposes, and which when once charged, continue, with very little attention, in constant and good working action for several months, may now be substituted for the batteries (*e. g.*, Grove's or Bunsen's) which it was formerly necessary to employ in order to attain sufficient quantity of current, and which only continue in good action for a few hours. Sand batteries have been repeatedly employed at Woolwich for the explosion of fuses, after having been in action four or five months, with the occasional addition of a little water to compensate for evaporation.

It will be seen, from the foregoing, that constant voltaic batteries combine more throughly the essential qualifications of efficient exploding agents, in connection with any system of submarine defence, than all other sources of electricity at present known. They are simple of construction, inexpensive, require but little skill or labour in their production and repair, and very little attention to keep them in constant good working order for long periods. Their action is quite independent of any operation to be performed on shore at the last moment; it is only necessary to place the cables leading to the torpedoes in connection with the battery when it is desired to close a defended water,—the circuit-closing portion of the torpedo, upon being struck by a ship at any time, will then cause the instantaneous explosion of the charge. The defence by torpedoes thus becomes as effective by night as by day; moreover, the efficiency of the constant batteries is not more prejudicially affected by the existence of defects in the insulation of the cables than that of the frictional electric machines; and they may be used without incurring any risk of the unintentional explosion of torpedoes by induced currents.

Simple and powerful forms of batteries are readily extemporised, and there is no more portable, simple or economical description of exploding instrument than the ordinary volta-pile, for the construction and employment of which it is only necessary to provide a piece of hard timber, some zinc and copper sheet, an old blanket, and some vinegar and common salt. A pile, composed of 120 elements, the plates being 2½ in. diameter, is very portable, and suffices to explode a mine in single circuit, or three or four arranged in branch circuit. It will remain in good action for at least twenty-four hours, and is readily and expeditiously cleaned and re-charged. This apparatus has become a favourite exploding instrument with sailors, being easily constructed and charged anywhere, and very handy for boat operations (in connection with the employment of torpedoes as an arm of attack), in which service more delicate instruments speedily lose in efficiency. Larger piles constructed on precisely the same plan are now being used in some ships of war for the simultaneous discharge of guns, and a very small form of pile, with water only as the exciting agent, is the most convenient instrument for testing the fuses and cables of torpedoes after they are in position. It is a matter of great importance that a positive knowledge of the efficiency of a torpedo and its conducting wire should be obtained from time to time by electric tests, and there is now no difficulty in including the fuses themselves in the test. Signals may, in fact, be readily passed from one firing station to another through the fuse in a submerged torpedo, which is arranged to be fired at will from the shore.

It does not come within the scope of this discourse to enter upon a discussion of numerous important subjects connected with the actual use of electric torpedoes, or of the considerations involved in the question as to how these formidable agents of defence may be most efficiently applied, in addition to, or in the absence of, artillery defences. The object of the discourse will have been attained if it has been satisfactorily demonstrated that electrical science is destined to contribute most invaluably to the efficiency of a country's defences.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

May 20th, 1869.

Dr. A. W. Williamson, F.R.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The following certificates were read:—

For the first time—Temple A. Orme, Teacher of Chemistry and Experimental Physics in University College School; W. Fletcher Barrett, Lecturer on Physical Science at the London International College.

For the second time—Wm. G. Valentin, Assistant in the Royal College of Chemistry, 126, Lancaster Road, Notting Hill; Thomas Gilham Hewlett, Surgeon, Bombay Army, Health Officer City of Bombay, Bombay; Captain A. Noble, Engineer, Elswick Ordnance Works, Newcastle; H. Stillington Grey Stephenson, B.A. Oxford, Sympsham Rectory, Weston-super-Mare.

The President announced that, in accordance with a letter he had received from M. Dumas, the Committee had made arrangements for the inaugural Faraday discourse to be given by M. Dumas on the 17th of June, and for the banquet to take place on the 18th.

The Secretary then read a short paper by Dr. Schorlemmer, "*On the Constitution of Hyposulphurous Acid.*" The author referred to the experiments of Dr. Dupré, and the views lately expressed by Dr. Odling, which seemed to be supported by Rose, who states that no hyposulphite is capable of existing which does not contain at least one atom of hydrogen, and proposes to reduce the molecular weight of hyposulphurous acid to one-half. The author thought that it could not be generally known that Rose's statement was incorrect. Pape* found all the hydrogen present in the form of water of crystallisation, which, with care, could be expelled without the salt being decomposed; but the last portion of the water is driven off at a temperature only a few degrees below that at which decomposition begins. By heating the sodium, potassium, and barium salts to 215° C., they can be obtained anhydrous, while at 5° higher they decompose. The lead-salt is anhydrous at 100°, but at a few degrees higher it blackens. In many reactions, the molecule of hyposulphurous acid split up in such a way that the atom of sulphur previously contained in the sulphur dioxide remained in the oxidised state, whilst the other atom separated as free sulphur, or a sulphide—

$$Na_2S_2O_3+2HCl=2NaCl+H_2O+SO_2+S.$$

$$Ag_2S_2O_3+H_2O=Ag_2S+H_2SO_4.$$

$$Hg_2(NO_3)_2+Na_2S_2O_3+H_2O=2HNO_3+Hg_2S+Na_2SO_4.$$

The author, therefore, thought that the old formula, proposed by Dr. Odling fourteen years ago, must be retained for hyposulphurous acid, and that it must be considered as sulphuric acid, in which one atom of oxygen had been replaced by sulphur.

* *Poggendorff's Annalen*, cxxii., 406.

Dr. Odling referred to the discussion which followed the paper by Professor Stokes, "On a Certain Reaction of Quinine," when, in speaking of the non-fluorescence of the hyposulphite, he ventured to say that it might be that, after all, the compounds of hyposulphurous acid were not really oxygen salts, but that they were, instead, halogen salts; and, in favour of that view, he had quoted the observation of Rose, but he was not aware that this observation had been refuted. He (Dr. Odling) would like to call to mind the different views put forward with regard to the hyposulphites. Having regard to empiric formulæ only, such a salt as sulphate of soda is represented as Na_2SO_4. The pentasulphide of sodium has the formula Na_2S_5, so the S_5 might be taken to correspond with the S and the O_4. The next salt in the list would be the intermediate one, $Na_2S_2O_3$, the ordinary mode of expresssing hyposulphite of soda. In Sir Robert Kane's "Manual of Chemistry," a salt was described having the composition $Na_2S_3O_2$, and it was said that this salt crystallised with the same number of atoms of water of crystallisation as the hyposulphite, and was isomorphous with it. Then there only wanted the intermediate salt, Na_2S_4O, of which he (Dr. Odling) had never heard; but, admitting the existence of the salt described by Sir Robert Kane, and accepting the other formulæ, they would have a complete series, as follows:—

$$Na_2SO_4$$
$$Na_2S_2O_3$$
$$Na_2S_3O_2$$
$$Na_2S_4O$$
$$Na_2S_5,$$

a series which seemed natural and likely to exist. If they oxidised sulphite of soda by any means, it became Na_2SO_4; and, if instead of oxidising it, they sulphurised it, it at once became $Na_2S_2O_3$; there was, therefore, an analogy in ultimate formulæ, and also an analogy in the particular mode of formation. Professor Kolbe had succeeded in making formic acid by reducing carbonic acid with sodium, thus: $H_2CO_3+Na_2$; and there was produced in this way formiate of soda, $NaHCO_2+NaHO$, which remained combined with the excess of carbonic acid. This reaction was, at first sight, very similar to the ordinary reaction by which a hyposulphite was obtained by the action of sulphurous acid. The hyposulphite could be obtained very readily by dissolving zinc or iron in sulphurous acid, but they would use sodium, as before, and they obtained a result which is capable of being expressed thus: $H_2SO_3+Na_2=NaHSO_2+NaHO$, which remains combined with the excess of sulphurous acid employed. This fact had led Dr. Dupré to form the opinion that carbonic and sulphuric acids were the analogues of each other. He (Dr. Dupré) made several experiments by acting upon carbonates with carbon, and the result of these experiments led him to believe that he actually formed formic acid. But the experiments, as Dr. Dupré acknowledged, could not be considered as altogether conclusive. With regard to formic acid, all experimental evidence tended to show that they had the carbon united with hydrogen and with oxygen, and also with oxygen already combined with hydrogen. But if they were right in saying that sulphurous acid was not an oxygen acid, the formic acid would be represented by $H(HO)CO$, and the hyposulphurous acid by $HHSO_2$, in which both of the hydrogen atoms are directly combined with sulphur. He (Dr. Odling) did not see that they were obliged to retain the old formula; the question was still an open one, and he thought the facts brought forward by Mr. Schorlemmer were as explicable to the new as to the old views.

The speaker then referred to the reactions which Mr. Schorlemmer gave, both of which, he thought, could be applied to the new way with as much or more ease than to the old. In speaking about the atom of water, Dr. Odling said that if they represented hyposulphite of soda according to the old-fashioned view, they had $Na_2S_2O_3H_2O$; but he preferred to write it $2NaHSO_2$. The

salt retained its atom of water with great firmness. It required a heat of 215° to drive off that atom of water from it: soda, silver, and baryta salts also required this unusually high temperature. This did not prove that the atom of water was different from water of crystallisation, but it was in favour of that view. He had said that it was impossible to drive off this atom of water, but, corrected by Mr. Schorlemmer, he would say simply that it was difficult.

Dr. Odling concluded by saying that it was a question on which he retained his mind quite open to bend in either direction as fresh facts arose, but, at the present moment, he did not think there were sufficient facts to enable them to absolutely decide the question, either one way or the other.

The PRESIDENT, in proposing a vote of thanks to Mr. Schorlemmer and Dr. Odling, thought there were two or three points brought forward by Mr. Schorlemmer which were entitled to some weight. First there was the tendency of hyposulphurous acid to form double salts of silver, sodium, &c. Among the characteristics of bibasic acids, that was one of the most conclusive, as a rule, and he (the President) thought it should weigh in Dr. Odling's mind as an argument in favour of the bigger formula. In reference to the decomposition into sulphur and sulphuric acid, it occurred to him whether there was not a difference in degree between believing that to occur by the splitting of the molecule, and believing it to occur by an action of the two molecules. There were cases which pointed to the greater facility for assuming that the result was an action in one molecule, than that it was an action of two molecules one upon another.

Mr. F. FIELD, F.R.S., then submitted a specimen of, and read a note on, sulphate of alumina from Iquique, Peru.

The following is the analysis, after deducting small quantities of chloride of sodium, oxide of iron, and silica:—

Sulphuric acid	35·56
Alumina	15·88
Water	48·56
	100·00

Corresponding to the formula $Al_2O_3,3SO_3+HO$, which requires—

Sulphuric acid	35·93
Alumina	15·57
Water	48·50
	100·00

Mr. W. H. PERKIN, F.R.S., then read a note "*On Regnault's Chlorinated Chloride of Methyl*," of which the following is a condensed abstract.

Last year the author read a paper before the British Association "On the Chloride of Methylene obtained by the Action of Nascent Hydrogen on Chloroform," which was afterwards published in this journal (CHEMICAL NEWS, vol. xviii., p. 56). The chloride of methylene obtained from chloroform was found to boil at about 41° C., the same temperature as that at which Butlerow's chloride of methylene boils. As Regnault gives the boiling point of chlorinated chloride of methyl much lower, namely, 30·5°, the author had made a fresh examination of the substance, to see if it were an isomer of chloride of methylene. After preparing a quantity of this substance, it was found to have a boiling point of between 40° and 42° C., and apparently to be identical with the chloride of methylene from chloroform. The author, however, has not yet completed its examination. Its composition was determined by its analysis and vapour density.

The PRESIDENT, in thanking Mr. Perkin for his communication, remarked that the experiments were strictly allied to a theoretical question now at issue amongst chemists, viz., that atoms had got bonds to them which were supposed to have different properties, and, accordingly, yielded different products.

Dr. HUGO MULLER stated that he had made some experiments with the view of finding out a good method for producing chloride of methylene; however, he found that at the best it was a long and tedious operation. The best result he obtained by simply dissolving the chloroform in alcohol, and adding hydrochloric acid and zinc with a few drops of platinum chloride. The whole is warmed slightly, in order to distil off the chloride of methylene as soon as it is formed, otherwise it is further acted upon and lost. He was trying some experiments with the object of obtaining bromide of methylene from bromoform, but the difficulty of obtaining the latter in quantity prevented him from going on with the experiment. He would be glad to hear of a practicable method for obtaining bromoform.

Dr. MILLS said it might easily be obtained by treating dicitrates with an excess of bromine. He had obtained a large quantity in that way.

Dr. MULLER had got, on the contrary, very unsatisfactory results with this method. The yield was very small in proportion to the citric acid used.

Mr. BASSETT had prepared, or attempted to prepare, bromoform in the way described by Dr. Mills, but he also found that the yield was exceedingly small—a very poor product.

Mr. PERKIN mentioned that he was at present engaged in an investigation of Bunsen's gaseous bromide of methyl.

The meeting was adjourned to the 3rd of June.

PHARMACEUTICAL SOCIETY.

Adjourned Meeting, Wednesday, May 5th, 1869.

H. SUGDEN EVANS, Esq., Vice-President, in the Chair.

Mr. CARTEIGHE recommenced the discussion of the subject introduced by Professor Redwood at the previous meeting. He did not agree with the most important practical suggestion made by Professor Redwood, viz., that in which he proposed to bend and modify the existing system of weights and measures, so as to gradually merge the one system into the other; there were great objections to such a process of bending.

The *tetram* or 4 gramme weight (one of the integers proposed by Professor Redwood) might be divided into tenths or into halves, quarters, &c, but they could not, as upholders of the decimal system, sanction the recognition of the octavial system involved in the latter. He did not think it would be easier to remember that the *tetram* was equal to one dram, and hence to four grammes, than to recognise the value of four grammes as such. He would rather suggest that a knowledge of the decimal system should be required by the Board of Examiners, and a book might be compiled as an addition to the British Pharmacopœia. The Pharmaceutical Society might also assist provincial societies in procuring complete sets of models illustrating the weights and measures of the metric system, so that anyone might handle and become practically acquainted with them. It would be hopeless to expect that much could be done in a short space of time. What they wanted for the present was a plan calculated to familiarise educated men of business with the metric system.

Dr. REDWOOD read a letter from Mr. F. Lowe, of Liverpool, who advocated the octavial system.

Dr. ATTFIELD considered there were immense advantages in a duodecimal over a decimal system, and an octavial was better than either, but as the world's system was a decimal one, ours should be so likewise.

Mr. BOTTLE, believing the system must ultimately be adopted, urged upon young men the necessity of making it an early study.

Mr. HASELDEN thought the system must be adopted some day, and looked to young men to make a study of it. He agreed with Mr. Carteighe in his proposal of an addition or supplement to the pharmacopœia. He would not like to see the metric equivalents added to the

pharmacopœia itself, side by side with our own. He considered the adoption of the French weighing practice, would be impeded by the aversion of the medical profession to making any change of the kind.

THE CHAIRMAN saw no great difficulties in the way. Mr. Carteighe had referred to the fact that the Board of Examiners would require a familiarity with the metric system. He considered that the Society should procure a perfect set of weight and measures for their own museum previous to assisting provincial societies, as proposed by Mr. Carteighe.

Mr. MARTINDALE thought there would be some difficulty in applying the system to dispensing, and in approximating metric weights and measures with the usual doses. He always found that medical students were taught the metric system in the laboratories at hospitals, and had subsequent difficulty in appreciating the value of grains, drachms, &c. He thought an octavial system was an impossibility.

Dr. REDWOOD thought the great defect of the present system was, that there were no integers between the grain and the ounce, and no relation between them. This had become so evident in compiling the pharmacopœia, that our present system could only be regarded as a temporary expediency. He confessed that he did not consider the metric system perfect, but he was somewhat surprised to hear he had been accustomed to condemn the system. A fault of the metric system was, that its integers had not been chosen because it was the best, but on theoretical ground; if our yard had been taken it would have been more convenient; our system is founded on experience, the metric on theory. The defects in our system must, however, be remedied, and the metric system seems to be the one generally adopted. We were the only advanced nation who had not adopted it; if we did so, it would soon become the international system. He (Dr. Redwood) thought that the difficulty would be in acquiring a knowledge of the value of its integers; to surmount this difficulty was the object of his proposals. Looking at a set of models in a museum would not suffice. He would like to have the weights marked on coin, the measures on postage stamps, &c., so as to associate the integers with objects with which we are familiar. He agreed with the proposal to enforce a knowledge of the system at the examinations, but he would only accede to the proposal to introduce weights and measures into the pharmacopœia on the condition that they were the exact equivalents. He would prefer a supplement.

Mineral Caoutchouc.—Recent communications from Adelaide, South Australia, have made known the discovery in the southern portion of the colony of a remarkable carboniferous substance, which hitherto has only been found in small quantity in the coal strata of Derbyshire, (England). It is a mineral caoutchouc, so called from its general appearance and elasticity. In Australia it is found on the surface of the sandy soil, through which it would appear to exude from beneath, as, burnt off occasionally by the bush fires, it is again found after the winter season, occurring in quantity and of varying thickness. Analysis proves it to yield 82 per cent or more of a pure hydrocarbon oil; its value for the manufacture of gas there will be great, and it is also believed to be applicable to the making of certain dyes. The discovery is also important from its indication of the existence of oils or other carboniferous deposits. This material, known in mineralogy as elaterite, is also found in a coal pit at Montrelais, near Nantes, France, at Neufchâtel, and on the island of Zante. According to the analyses of the late Professor Johnston, of Durham University, it is a hydrocarbon containing from 83·7 to 85·5 per cent of carbon, and from 12·5 to 13·28 per cent of hydrogen. The variety found in Derbyshire (near Castleton) has a specific gravity varying between 0·9053 to 1·233; the substance is highly inflammable, its colour blackish brown, its lustre resinous.—*Mining Journal.*

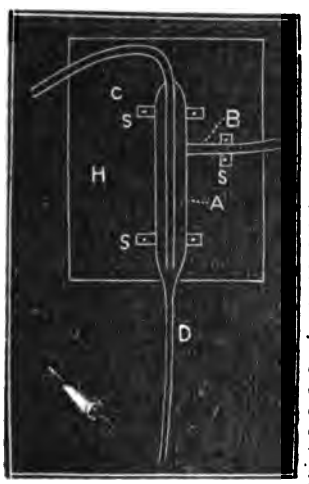
LABORATORY NOTES.

LABORATORY PUMP.

To the Editor of the Chemical News.

SIR,—As you published some weeks ago an account of Professor Bunsen's valuable filter pump, I may take the opportunity of describing a simple form of this pump which has been fitted up in my laboratory by Mr. Stephen Yeates, of Dublin.

The accompanying diagram shows the essential parts of the pump. A is a tube of tin, about eight inches long, and of nearly one inch internal diameter; within three inches of one end the tube B is soldered. The diameter of this tube should be about ⅛ of an inch. The end of the wide tube most distant from B is now contracted so as to form a portion of a cone, and D then soldered in. A small tube, C, is now selected, one extremity of which enters, but must not at all close, the cone formed by the junction of A and D; and this point its orifice is contracted, so as not to exceed ¼ of an inch in diameter. It is then soldered, as shown, into the upper end of A. The whole arrangement is fitted to a board by the straps, S, S.



The tube, C, is connected with the vessel to be exhausted of air. B is the delivery pipe for water, obtained from a cistern or from the street main; the supply should admit of regulation by means of a stop-cock placed in the course of B. In order to obtain the maximum exhaustion with the pump, the length of D should be about thirty-three feet, but a fall of twenty feet I find to be more than sufficient for ordinary water. As this form of Bunsen's pump can be constructed by any intelligent plumber for a few shillings, no chemist need be deterred, either on account of expense or trouble, from fitting his laboratory with the new apparatus.

I have had the pump in operation in my laboratory for about two months, and gladly bear testimony to the great practical value of Professor Bunsen's admirable arrangement.—I am, &c.,

J. EMERSON REYNOLDS.

Laboratory, Royal Dublin Society,
Kildare Street, Dublin,
April 26th, 1869.

CORRESPONDENCE.

ALKALI WORKS.

To the Editor of the Chemical News.

SIR,—In my letter on "Alkali Works," which you kindly published on the 14th inst., I did not explain my ideas very fully for fear of intruding too far upon your valuable space, but after your remarks in last week's CHEMICAL NEWS (and for which I heartily thank you), I request your indulgence while I make a few supplementary notes.

Alkali Works are now generally conducted by men with considerable scientific and practical knowledge, and much care and attention is applied in order to obtain in all cases

the full produce, *i.e.*, as near the theoretical as possible, from all materials, whether solids or gases, and as this can be and is accomplished without any appreciable loss, I assumed and worked upon this assumption when I made my remarks, that no gas did or was liable to escape, except muriatic acid, and as this was under the supervision of an inspector appointed for the purpose, I considered that he was the one to prosecute if such was neccessary.

To expect no odour whatever from a chemical works is too much, as it is, for instance, impossible to run still liquor off without a slight smell; but any constant escape of sulphuric or nitrous gas is quite unnecessary, and in such cases by all means let farmers and others have some means of getting redress for damage done. But, again, care must be taken that a system of *persecution* is not resorted to; and without a Court is formed for the trial of these cases, which can sift and understand the *scientific defence* of the defendants, such a state of things will result, as, for instance, I see before me a chemical works surrounded by a few other works, not alkali, but for all that emitting acid gases (glass, and other works). These are situated in an agricultural district, and, consequently, the people about there are more sensitive at their nasal members. The alkali works may have got an hereditary bad name, but no gas is allowed to escape now, yet the representatives of agriculture in that neighbourhood would, in case they saw their crops injured by gases, at once complain of the alkali works and never suspect the glass works. The reason of this is, that the uninitiated, in passing the former works, no doubt will smell an odour, while, in passing the latter, they will not smell any, and they at once, in their ignorance, put down as a fact, that the alkali is the guilty work. They do not know that, if an alkali work is properly conducted, no gas, in such a quantity as to do harm to agriculture, is allowed to escape, and that the mere puff or smell they experience in passing is quite unavoidable (as coming off, say, still liquor when being run off), but, at the same time, quite harmless, although it does go direct and affect their smelling power. Again, in their ignorance, they are not aware that other works, such as glass, are allowed to evolve *streams* of gas from their chimnies, which, instead of making itself known to every passer-by, goes, or rather is blown quietly, but in an unremitting stream, on to the adjoining fields. If a case of this sort was brought before a county court, as at present constituted, the verdict would go against the alkali manufacturer, because the judge, not understanding the chemical defence, would take the same view of the case as the farmer. I beg to ask if this state of things is fair?

For my part, I do not by any means wish to deprive farmers and others from complaining, but, knowing as I do the care that is taken by some people to prevent, and how unnecessary it is to allow gases to escape, I only wish that justice may be done to those who, perfectly innocent, may yet be so unfortunate as to be blamed for gases allowed to escape from contiguous works, unsuspected, perhaps, simply because they are *not* alkali works.—I am, &c.,

AN INTERESTED PERSON.

MISCELLANEOUS.

A Curious Laboratory.—We read in the *Lancet* that M. Sainte-Claire Déville, in connection with his scheme for substituting the mineral oils for coal as fuel in the French fleet, has undertaken a series of experiments, in which he will study the effects of pressure on various phenomena, and especially the causes of light in flame, of combustion, &c. In order to pursue these researches, it has been thought necessary to construct a large iron laboratory, capable of receiving the experimenter with all his apparatus, and which may be subjected to an extraordinary atmospheric pressure by means of suitable pumping apparatus. This iron safe has the form of a vast cylinder, surmounted by two chimneys, one serving to connect the pressure pumps, and the other to admit the operator and his apparatus. The experiments will be conducted by M. Sainte-Claire Déville and some other *savants*, and will involve a certain degree of danger. No doubt of this latter assertion; *queritur*, how their lungs and brain will feel under increased atmospheric pressure.

Ozonisation of Hydrocarbon Oils.—M. Grotowsky, of Halle on the Saale, has made known some interesting facts on a new property of various hydrocarbon oils, which he has discovered. Exposing various kinds of oils in glass flasks to the rays of the sun for a period of three months, he found invariably that they absorbed oxygen and converted it into ozone. The air was ozonised even in well-corked vessels, the effect being, however, to some degree dependent upon the colour of the glass. The respective results were noted after the lapse of three months. American kerosene, from petroleum which had been exposed to light in white uncovered glass balloons, had become so strongly ozonised that it scarcely burned. The originally bluish white oil had assumed a vivid yellow colour, and the specific gravity was found to have increased 0·005. American kerosene, which had been kept in the dark for three months, did not show any ozone at all, and burned satisfactorily. The oils were exposed from April to July, 1868; those which had become strongly ozonised had also suffered a distinct change in odour, and the corks were bleached as if attacked by chlorine, while the other oils had remained unchanged in these particulars. These results are fully confirmed by the experience of the consumers as well as of the dealers in these oils, who all avoid obtaining "old oils" as they call them. It appears that re-distillation, with quick-lime and clean iron nails, restores the oils to their original state and properties. —*Engineer.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we are endeavouring to effect arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

Neues Jahrbuch für Pharmacie redigirt, von Dr. Vorwerk, No. 3, 1869.

The present number of this periodical contains the following original papers:—

"*Soluble Saccharate of Oxide of Iron as Antidote against Arsenical Poisoning*," by Dr. H. Köhler. This is a paper containing the description of a series of experiments made upon living animals.—"*Characteristics of the Akasga Plant, and the Structure of its Wood, as compared with that of the Strychnos nux vomica*," Dr. R. Fraser. A botanical essay.

The remainder of the pages of this number of the periodical are filled with short abstracts taken from various periodicals published in England, France, and Germany; the greater portion interesting to our readers has been already published in these pages, we therefore confine our communication to the following:—

Analysis of Crude Cream of Tartar, Argol.—One gramme of this substance, taken from a thoroughly well mixed large average sample, previously powdered, is weighed into a tared porcelain crucible; the crucible and contents are heated to redness, and kept ignited until the contents are quietly in igneous fusion; let the weight of the residue found after cooling be called p. The crucible and contents are next boiled in distilled water, the fluid separated by decantation from the sediment is set aside, and the sediment washed until the wash-water no longer turns red litmus blue; the insoluble residue is dried at first on a water- and next on a sand-bath. After its weight has been ascertained, it should be called r; $p - r$ is equal to the soluble portion of the ash which represents the carbonate of potassa. When the result of $p - r$, expressed in grammes, is multiplied by 271, the percentage of pure bitartrate of potassa is obtained contained in the sample of crude argol submitted to experiment; when the result of $p - r$ is multiplied by 216, the percentage of crystallised tartaric acid is obtained.

Instability of the Solutions of Alkaloids.—A solution of 1 grm. of sulphate of quinine, 50 centigrms. of tartaric acid, and 20 grms. of water, was tested, after having been standing in a stoppered bottle for twenty months. It contained 1·05 grms. of the saline constituents, instead of 1·40 grms., as when first prepared; it lost, therefore, 25 per cent. It appears, from communications received from various parties on this subject, that the same is observed to take place with most other alkaloids applied in pharmacy, and such solutions should not, therefore, be prepared for use in too large a quantity at the time.

Method of taking away the Bitter Taste of Epsom Salts.—When, in a solution of 30 grms. of this salt in 300 grms. of water, 10 grms. of roasted and ground coffee is boiled, and the fluid filtered, the bitter taste of the salt is entirely taken away, and the fluid pleasant to take.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, T. xiii., No. 4.

This paper does not contain any communications which are of any value for our purpose; most of the communications do not refer to exact sciences, and those which do, bear upon physiology, comparative anatomy, and crystallography.

Bibliothique Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 136, April 15, 1869.

The following are original papers:—

"*Velocity of the Psychical Functions of the Brain*," by Prof. F. C. Donders.

Adhesion of Hydrogen to Metals.—M. A. De la Rive.—The author, referring to a paper published by him in 1843, has now repeated some experiments, in order to prove that the pressure of the air, by facilitating the adhesion of hydrogen to metals, may become an impediment to the continuation of some chemical reactions, which, on being first called into play, are not affected by this cause.

As regards the remaining papers in this periodical, as far as they belong to chemistry, we have already published their contents; the said papers not being original communications, but abstracts from works and periodicals published in various countries.

Zeitschrift für Chemie, von Beilstein and others.

The seventh number of this periodical for the present year contains the following original papers, some of which are very lengthy, and can, therefore, be only briefly noticed:—

Synthesis of Hydroparacoumaric Acid.—MM. Glaser and Buchanan.—They have essayed to substitute, for a hydrogen atom in the benzol nucleus of phenylpropionic acid, hydroxyl, in the radical C_9H_9 of the acid just alluded to; this they have done by first preparing the amido acid of the nitrophenyl-propionic acid, next converting that amido acid into the diazo combination, and, lastly, by decomposing that compound, by boiling it with water. They thus obtained para-oxyphenyl-propionic acid, which, on being tested, proved to be identical with hydroparacoumaric acid. In the course of their researches, the authors have met with a great many new compounds, among which the nitrophenyl-propionic acid—

$$C_6H_4 \begin{cases} NO_2 \\ C_3H_5O_2. \end{cases}$$

This is a solid substance, crystallises, exhibiting pale yellow crystals, difficultly soluble in cold, more readily in warm water, and very easily in alcohol and ether, and fuses at 153° C.; this acid forms readily soluable salts, which, however, crystallise difficultly. Hydrocabostyrol is also a solid substance; its formula is C_9H_9NO, fuses at 160° C., and can be distilled over at a higher temperature without decomposition. Amidophenyl-propionic acid—

$$C_6H_4 \begin{cases} NH_2 \\ C_3H_5O_2, \end{cases}$$

Again a solid substance, crystallising, and then exhibiting beautifully-quadrilateral prisms fusing at 131° C.; this substance forms, with acids, divers crystalline compounds. The other compounds we only briefly name, are the chloride of the diazophenyl-propionic acid, the oxyphenyl-propionic acid, and the parabromophenyl-propionic acid.

Action of Hydrobromic and Hydrochloric Acids upon Nitrobenzol.—H. Baumhauer.—Two and a half parts, by bulk, of a freshly-made aqueous solution of hydrobromic acid were mixed with one part, by bulk, of nitrobenzol, placed in a glass tube, and this, after having been sealed, was exposed to a temperature of from 185° to 190°. In this manner two substances were obtained—to wit, dibromaniline, which was in solution in the state of hydrobromate, and tribromaniline, which was left as an insoluble solid. When the experiment was repeated with hyrochloric acid, a crystalline substance was obtained, which the author has not further investigated.

Some of the Decompositions of Bromonitrous Acid.—M. L. de Koninck prepared this acid by means of saturating bromine cooled down to −10° with deutoxide of nitrogen; when an alcoholic solution of this compound is added to an alcoholic aniline solution, among other products, diazoamidobenzol is formed; when the aforesaid alcoholic solution was made to act upon nitrate of aniline, the author obtained a corresponding diazo compound. From these, and a series of similar experiments, the general result arrived at is that bromonitrous acid acts upon aniline as anhydrous nitric acid does upon that substance.

New Method of Preparing Cymol from Camphor, and on a Hydroxyl Derivate of Cymol.—Dr. R. Pott, while experimenting with camphor ($C_{10}H_8O$), tried to displace its oxygen by sulphur; and with that view he made sulphide of phosphorus, P_2S_5, act upon the substance; but, instead of succeeding with his intended substitution, he obtained cymol, since the sulphide of phosphorus acts by withdrawing water from the camphor, while, as by-product, a small quantity of a resin is formed at the same time. The best proportions for obtaining cymol by this method are five atoms of camphor to one atom of P_2S_5; the product obtained is purified by means of concentrated solution of caustic potassa and rectification over sodium. The hydroxyl derivative is obtained by fusing cymol with an excess of a mixture of potassa and sulphite of potassa, whereby a substance is formed the formula of which, after having been properly purified previous to analysis, is $C_{10}H_{14}O$, a substance, therefore, to which the name thymol applies.

Hydroxyl Urea.—Drs. Dresler and Stein find that this substance originates when cyanate of hydroxylamine is formed from cyanate of potassa and a salt of hydroxylamine; the preparation of the hydroxy urea, $N_2CH_4O_2$, is very complex, and, in consequence of the manifold operations required, too lengthy for description here. The resulting substance just alluded to is a solid, readily soluble in water, crystallises from alcoholic solutions in needle-shaped crystals, and fuses at between 128° and 130° C.; but if it be kept at this temperature for some time, it is decomposed, carbonate of ammonia is given off, and ordinary urea left. It is probable that the hydroxyl urea is, however, during this process of decomposition, first split up into cyanic acid and hydroxylamine. Solution of caustic potassa and strong nitric acid immediately decompose the hydroxyl urea. The author describes, also, a substance which he calls hydroxylbiuret, the formula of which is $N_3C_2H_5O_3$; it is a solid, soluble in water and alcohol, fusible at 134° C., but very readily decomposed, if kept, even for a few minutes, at this temperature.

Combination of Phosphoric Acid and Urea.—MM. Schmeltzer and Birnbaum have repeated some of Lehmann's experiments on this subject; they dissolved urea in a concentrated solution of ordinary phosphoric acid, and evaporated the fluid, without being warmed at all, over sulphuric acid in vacuo. In this manner a crystalline mass is obtained, which may be purified by re-crystallisation, after having been dissolved in distilled water and cautiously evaporated on a water-bath; the crystals thus formed belong to the rhombic system, are readily soluble in water and alcohol, difficultly so in ether. The substance becomes decomposed when it is heated above 100°, giving off ammonia and carbonate of ammonia, and leaving metaphosphoric acid; the formula of this substance is CH_4N_2O,H_3PO_4. The authors state that other similar compounds have been obtained by them, and among these one containing 39 per cent P_2O_5, but this substance does not assume a crystalline shape.

Under the title of "Results of Researches made in the Chemical Laboratory of Professor Engelhardt, at St. Petersburgh," a paper follows, which is divided into three sections, each having a separate title:—1. "*Nitrotoluol and Amidotoluolsulpho Acids*," by M. Bek. 2. "*Isomeric Toluidine Sulpho Acids*," by J. Malyscheff. 3. "*Isomeric Naphthol and Benzoylnaphthol*," by Maikopar." However interesting these researches may be, the papers are too concisely written to admit of useful abstraction; and, from a foot-note placed at the end of these essays, we learn that researches on the same subjects have been made simultaneously elsewhere, and published, previous to the authors of the researches here referred to having had time to get their work printed and published in German.

The remaining few pages of this number of the periodical are filled with short paragraphs taken from the CHEMICAL NEWS, *Comptes Rendus*, and other periodicals, the subject matter of all of which has been noticed and published in our pages.

Les Mondes, Revue Hebdomadaire des Sciences, May 13, 1869.

We briefly notice, from the contents of this weekly paper, which are extremely varied, a proposal by M. Guignet—

To Preserve Butcher's Meat in Hot Weather, by placing it in large earthenware pans, putting clean heavy stones on it, and covering it with skim milk; the milk will become sour, of course, but may afterwards serve as food for pigs, and the meat will be found to have kept its natural primitive freshness, even after eight or ten days.

Bronze.—It appears that at Berlin experiments have been made to determine under what circumstances the metallic alloy known as statuary bronze becomes most readily covered with what is technically called *antique patina*. As the result from a series of experiments, it appears that when genuine bronze is kept well cleansed, by washing the objects made of it with water, and next varnishing with oil, and rubbing the latter off with a piece of woollen stuff, and repeating this process once a month, it will produce the desired coating of patina very rapidly. Few of our readers acquainted with London are aware, perhaps, that the lamp-posts on London Bridge are, not as they seem, cast-iron, but genuine bronze, which of course, owing to the atmosphere it is exposed to, has become black.

Among the papers on geognosy, we meet with an interesting account of amber, too long for abstraction. This latter observation also applies to a paper of M. Dufour, on "*An Improved Method of Examining the Flame of Burning Bodies and the Structure thereof.*"

The remainder of the papers relate to pure mathematics, and a long account of the meeting of the French Academy of Sciences.

Bulletin de la Société d'Encouragement, No. 195, March, 1869.

All the original papers of this number bear upon matters of engineering and mechanical science. The industrial notices contained in this publication, taken, as they are, chiefly from German papers, are rather antiquated; we only briefly notice—

Good Wholesome Bread.—Professor Stohmann advises to mix to ⅔ parts of rye meal, ⅓ part of bean, or pea meal, and 2 per cent, by weight, of the mixture, of ordinary common salt. It appears that bread thus made is of excellent quality, taking its constituents into consideration, and easily digestible.

Copal Varnish, according to Professor Böttger's prescription, should be made by first dissolving one part, by weight, of camphor, in twelve parts of ether; when the camphor is dissolved, four parts of the best copal resin, previously reduced to an impalpable powder, are added to the ethereal camphor solution, placed in a well-stoppered bottle. As soon as the copal appears to be partly dissolved, and has

become swollen, four parts of strong alcohol, or methylated spirits, and ¼ part of oil of turpentine is added, and, after shaking the mixture, and letting it stand for a few hours longer, a thoroughly good copal varnish is obtained.

Berichte der Deutschen Chemischen Geselschaft zu Berlin, No. 6, 1869.

At the meeting of the Society held on the 22nd of March, under the presidency of Professor A. W. Hofmann, the following papers were read:—

Peculiarly-Modified Physical Structure of Banca Tin.—M. J. Fritsche states, that during the intense cold of the winter weather at St. Petersburg in the months of December, 1867, and the first three months of the following year, a large quantity of blocks of Banca tin, warehoused in that city, had been entirely changed in physical properties; the metal was swollen up, and the inside of the blocks, which had become simultaneously very brittle, so as to break very easily, had been entirely honeycombed. M. Fritsche instituted some experiments, by submitting tin of the same kind, not previously affected by the winter cold, to the action of an artificial freezing mixture made of solidified carbonic acid and anhydrous ether, without obtaining anything like the results produced by the long-continued intensely cold winter. No chemical change had been produced; as usual, this kind of tin was of great purity.

Some Derivatives of Naphthol and Naphthobioxyl.—MM. Darmstädter and Wichelhaus.—The authors say that they have met with considerable difficulty to obtain nitro-derivatives of naphthol by directly acting with nitric acid upon that substance; when, however, a solution of naphthol-sulphuric acid is placed in contact with nitric acid, a red colouration ensues, and a solid yellow-coloured substance is precipitated; this substance is the binitronaphthol, which crystallises from its solution in chloroform, and fuses at 138° C. Naphtho-bioxyl, obtained by fusing naphthalin-bisulphuric acid (naphthalin-bisulfosaure) with caustic potassa, is a solid substance which crystallises in colourless needle-shaped crystals, soluble in alcohol, ether, and chloroform, difficultly soluble in water; formula, $C_{10}H_6(OH)_2$.

Changes which Orthoformic Ether Undergoes.—M. H. Wichelhaus.—Orthoformic ether, $CH(OC_2H_5)_3$, when heated in sealed tubes with liquid ammonia, did not yield the product the author sought for; but, on repeating the experiment with aniline and the same ether, a solid substance was obtained, which, on being submitted to elementary analysis, yielded results leading to the formula $C_{13}H_{12}N_2$, thereby proving, in connection, also, with the chemical and physical properties of the substance, that it is identical with the body Dr. A. W. Hofmann obtained from chloroform and aniline.

"*Substances Isomeric with Hydrosulphocyanic Ether which agree with the Essential Oil of Mustard*," by Dr. A. W. Hofmann. This lengthy and very concisely written, and evidently condensed, paper, is too long for abstraction, with due justice to the merits of the researches described and to the eminent author.

The papers which follow, and the correspondence, have been noticed in our pages already.

Annales du Génie Civil, April, 1869.

As may be expected from the title, this periodical only occasionally contains papers, or communications, relating to chemistry. We notice in this number:—

Bachet's Process for the Manufacture of Caustic Soda.—When litharge, chloride of sodium, and water are mixed together, oxychloride of lead is formed, and soda set free, according to the following equation:—

$$4PbO + NaCl + HO = (PbCl + 3PbO) + NaOHO.$$

The oxychloride of lead thus produced being treated with milk of lime, chloride of calcium is formed, and oxide of lead reproduced according to this equation:—

$$(PbCl + 3PbO) + CaO = CaCl + 4PbO.$$

The operation, therefore, consists in making oxide of lead act upon common salt, exhausting the soda thus formed by washing out with water and evaporating the alkaline fluid. The oxychloride of lead being insoluble, is placed in suitable apparatus, and mixed therein with lime-water, whereby the oxychloride is re-converted into protoxide of lead. The chloride of calcium obtained as by-product is, however, at present almost entirely valueless.

New Manure.—We learn from the same paper that a double salt of sulphate of ammonia and sulphate of manganese, found in the mother liquors remaining from the boracic acid manufacture at the *lagoni* of Tuscany, a salt hitherto useless, though containing from 7 to 8 per cent of ammonia, and about 10 per cent of protoxide of manganese, is now applied as manure, instead of crude sulphate of ammonia, and gives excellent results; as attested, also, by the well-known Prof. George Ville.

Comptes Rendus des Séances de l'Académie des Sciences, Monday, May 17, 1869 (No. 20).

Omitting matters of purely mathematical, astronomical, and mechanical interest, we notice the following memoirs:—

Expansion, by Heat, of some Metallic and Non-Metallic Simple Bodies, and some Compounds of Hydrogen and Carbon.—M. Fizeau has experimented upon some forty substances, nearly one-half of which number has been for the first time submitted to a rigorously exact method of determining the co-efficient of expansion by heat between 10° and 80° C., and with masses varying from 2 to 16 m.m. The co-efficient of linear expansion of diamond is equal to 0·00000118; that of graphite, 0·000007̄86; that of pure cast platinum, 0·00000899; that of cast gold, 0·00001443; that of cast silver, 0·00001921; that of copper, native from Lake Superior, 0·0000169. These figures we quote only as instances of the amount of labour bestowed by the author on a subject requiring great nicety of manipulation.

On the Kaolin of La Lizolle and Echassieres, Departement of Allier, and Existence of Tin Ore at the same spot, which has been worked in remote antiquity.—M. Daubrée.—Although this memoir is certainly of local interest only in its geological, mineralogical, and commercial bearing, it deserves to be noticed, on account of the fact that the working of these kaolin beds, situated almost in the very centre of France, have been, at a very remote period of antiquity, the scene of mining operations, executed with the view of obtaihing tin ore, from which, moreover, metal has also been wrought there, as evidenced by vestiges of furnaces found in the neighbourhood.

Some Properties of Chlorosulphide of Phosphorus.—M. Chevrier.—Chlorosulphide of phosphorus, $PSCl_3$, is a colourless liquid, possessed of a rather irritating, but not at all disagreeable odour; boils at 124·5° C.; (when barom. 750 m.m.) at 20° C., its specific gravity is 1·636; its vapour is difficultly combustible, and forms, when mixed with oxygen, a slightly explosive mixture. This substance is not decomposed by a strong electric current, or a series of electric sparks. When the vapour of this substance is made to pass through a red-hot porcelain tube, filled with pieces of broken porcelain, the vapour is partly decomposed, sulphur is deposited, and a mixture of chlorosulphide and protochloride of phosphorus distils over. Water has the effect of slowly decomposing the chlorosulphide of phosphorus, thereby converting it into phosphoric, hydrochloric, and hydrosulphuric acids. This substance is also decomposed by chlorine; iodine and sulphur are readily soluble in this liquid, which is not acted upon by metals at the ordinary temperature of the air. Space forbids us here to enter into more particulars on the chlorosulphide of phosphorus, which has been exhaustively studied by the author.

"*Physical Constitution of the Sun; on the Results obtained by Spectrum Analysis, and by the Study of the Rotation of that Heavenly Body.*"—M. Faye, though an enthusiastic admirer of the results obtained by spectrum analysis, considers that the study of the mechanical effects of the rotation of the sun in producing certain phenomena on its surface, and in its photosphere, should not be neglected.—"*Influence of Temperature, as Affecting the Deviation of Gases from Obeying Mariotti's Law*," by M. Amazat. This is a condensed abstract from a larger paper, and too abstruse for further condensation.

Researches on the Phosphoric Acid present in that portion of Arable Soils which is Insoluble in Aqua Regia.—M. de Gasparin.—The labours of this gentlemen reveal the fact, that even where there is the least appearance of the presence of phosphoric acid, it is met with in a quantity, which, if calculated for a surface of 1 hectare (2,471 acres), proves it to be relatively pretty abundant, though it be in a rather insoluble form. As instances, we take granitic sand from near Annonay (Ardèche), which in this way contains 0·62 per cent of its weight of this acid, amounting to 24,000 kilos. to the hectare. The siliceous diluvial sand of the borders of the Mediterranean contains 0·49 per cent, or nearly 20,000 kilos. to the hectare.

Solubility of Sulphur in the Coal-Tar Oils.—M. E. Pelouze.—Coal-tar oil, of 0·885 sp. gr., and distilling over at between 146° and 200° C., dissolves, at 15°, 2·3 grms. of sulphur; at 40°, 5·6 grms.; at 65°, 10·6 grms.; at 100°, 25·0 grms.; at 110°, 30·3 grms.; at 130°, 43·2 grms. As soon as the temperature decreases, the sulphur is precipitated in crystalline state, so that when the temperature was 130°, and the quantity of sulphur dissolved 43·2 grms., on cooling down to 15° only 2·3 grms. remain dissolved, and 40·9 grms. are precipitated. This property of the heavier coal-tar oils is made use of at the Paris gas-works to extract, from the materials which have been used in purifying gas according to Laming's process, the sulphur therein contained. The author of this paper reports very favourably on this plan, as greatly superior and less dangerous than the use of sulphide of carbon for that purpose.

This number also contains several papers relating to meteorology, and among these a very circumstantial account of the death, by lightning, of Captain Lacroix, of the Imperial Engineers, who was killed on the 7th of May last, while in his tent at the camp of Châlons-sur-Marne.

The American Journal of Science and Arts, March, 1869, No. 140.

This well-known and deservedly valued periodical contains, in its present number, the following original papers:—

"*Some Phenomena of Binocular Vision*," continued from a previous number, by Prof. Joseph Le Conte.

New Salt, containing Tin, Cæsium, and Chlorine.—S. P Sharples.—This almost insoluble salt was accidentally discovered, and after having been purified, was found, on analysis, to consist, in 100 parts, of—chlorine, 35·84; tin, 19·49; cæsium, 44·67. The new salt will not serve for a quantitative separation of cæsium, as it is slightly soluble even in strong hydrochloric acid. Alcohol does not seem to have any influence upon the precipitation. If stannic chloride is added to a neutral solution containing CsCl, no precipitate is formed; but, upon adding to the solution about its own volume of strong hydrochloric acid, the salt is at once thrown down.

"*Atomic Volume of Liquids*," by Frank Wigglesworth Clarke. This extremely interesting and very concisely written paper is too lengthy for abstraction, an observation which equally applies to Dr. Wolcott Gibbs's paper "*On the Wave Length of the Spectral Lines of the Elements.*

"*Condition of our Knowledge of the Processes in Luminous Flames*," by Eugène W. Hilgard.—This paper contains a review of what is at present precisely, and with absolute certainty, known on a subject which, as the author well remarks, has been too much taken for granted. His paper, full of quotations from the papers and published memoirs containing the results of experiments by himself and many other scientific men, is too abstruse for abstraction.

Notices of New Meteoric Irons in the United States.—Charles Upham Shepard.—Meteoric Iron from Auburn, Macon County, Alabama; specific gravity varied from 7·0 to 7·17, and gave 7·05 as the mean. The iron is free from chlorine, dissolves in hydrochloric acid without giving off sulphuretted hydrogen, and leaves behind a slight residue of thin, brilliant, blackish scales and needles. Its percentage composition, by analysing 2 grms. weight, was found to be:—Iron, 94·580; nickel, 3·015; phosphorus, 0·129; insoluble, 0·523; chromium, magnesium, caldium, silicon (?), and loss, 1·753; total, 100·000.—Meteoric Iron from South-Eastern Missouri. Specific gravity, 7·015—7·112; no chlorine. In 100 parts:—Iron, 92·096; nickel, 2·604; schreibersite, 5·000; chromium, cobalt, magnesium, and phosphorus, traces; a fine residue of $Fe_2O_3SiO_3$ and C. Neither copper nor tin was found.—Meteoric Iron from Losttown, Cherokee Co., Georgia. In 100 parts:—Iron, 95·759; nickel 3·660; insoluble, 0·580; chromium, cobalt, tin (?), and magnesium, traces.

"*Nitrification*," by S. W. Johnson, is an essay on this subject, condensed from a lecture delivered before the National (American) Academy of Sciences.—"*Geological Notes on the Andes of Ecuador*," by James Horton.—"*Observations on Autumnal Foliage*," by Joseph Wharton, is a paper on chlorophyl and some observations and experiments made on this substance by the author, to which he has appended short abstracts containing the records of the results of the experiments on chlorophyl by Prof. Frémy and others; the author's experiments have more a physiologico-botanical, than a chemical bearing.

Modified Form of the Nitrate of Silver Test for Arsenic Acid.—Charles E. Every.—The author has thoroughly studied and experimented upon this subject. It is known that arseniate of silver is slightly soluble in an aqueous solution of nitrate of ammonium, and readily soluble in both ammonia and dilute nitric acid; it is not easy to detect small quantities of arsenic by means of nitrate of silver, as usually employed, unless the test be applied with extreme care. The author found that the addition either of acetate of sodium, acetate of ammonium, or Rochelle salt, to a mixed solution of arsenic and nitric acids, is sufficient to ensure the immediate precipitation of arseniate of silver when ammonio-nitrate of silver is introduced. Instead of the acetates or tartrates, recently precipitated carbonate of silver may be employed to neutralise free nitric acid. When present in relatively large quantity, arsenic acid readily precipitates silver from a solution of nitrate of ammonium and ammonio-nitrate of silver, but the colour is uncertain.

Next follow:—"*Notices of Papers in Physiological Chemistry*," by Dr. George F. Baker; a long essay continued from a former number of this periodical. The scientific intelligence which concludes this number is partly abstracted from articles of journals and periodicals published in Europe, and is partly of local interest only.

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1143. P. A. Blake, Highbury, Middlesex, "An improved safety explosive compound, and the apparatus connected with its use."—Petition recorded April 14, 1869.

1193. J. Horsley, Cheltenham, Gloucestershire, "Improvements in the manufacture of blasting powder or explosive compounds."—April 19, 1869.

1260. J. Major, W. Wright, Swallow Street, Middlesex, and G. H. Jones, Alpha Road, Middlesex, "A new or improved manufacture of white-lead, and apparatus employed therein."—April 24, 1869.

1361. P. Southern, Top Lock, Aspull, near Wigan, Lancashire, "Improvements in furnaces."—May 3, 1869.

1380. W. MacKean, Paisley, Renfrewshire, "Improvements in the manufacture of cattle food."

1381. E. H. Richmond, King William Street, London, "Improved apparatus and process for preserving fresh meat and other animal food, fish, poultry, and game; also ingredients, matters, or substances to be used in combination with the said apparatus."

1383. H. Highton, M.A., Brighton, Sussex, "Improvements in making, hardening, and preserving artificial stone, and in preserving the surfaces of walls and other surfaces."

1388. T. Welton, Grafton Street, Fitzroy Square, Middlesex, "A new method of applying oxygenated and other gas-charged charcoal, for curative and other purposes."—May 5, 1869.

NOTICES TO PROCEED.

3945. E. Butterworth, Calder Cottage, near Rochdale, Lancashire, "Certain improvements in or applicable to furnaces."—Petition recorded December 26, 1868.

3965. A. G. Cazalet, Rue Gaillon, Paris, "Improvements in the manufacture of steel, and in the apparatus employed therein."—December 30, 1868.

26. W. Prosser, Lancaster, "Improvements in the purification and bleaching of oils, gums, and resins and spirits."—January 5, 1869.

905. J. J. Bodmer, Newport, Monmouthshire, "Improvements in the manufacture of iron and steel, and in the apparatus to be employed therein, part of which improvements are also applicable to the treatment of other metals and alloys."—March 25, 1869.

1083. J. Dewar, Kirkcaldy, Fifeshire, "Improvements in treating certain substances for food and for manure.—April 9, 1869.

NOTES AND QUERIES.

Alizarine.—It is as yet impossible to answer this question, since Messrs. Graebe and Liebermann do not manufacture on a sufficiently large scale to judge of the commercial success of their process.—F.

Bread for Diabetes.—Bread composed of gluten of wheat without starch, or bran-cakes baked with eggs, have been recommended. It is very likely that some of the higher-class bakers of the West End shops keep, or at least, if required, make, bread of this kind, as is the case in Paris.—H. C. S.

Bread for Diabetes.—Take coarse wheat-bran, wash it with water on a sieve until the water passes through clear, dry it in an oven, and grind to a fine powder by a mill. Take seven eggs, 1 pint of milk, ¼ lb. of butter, a few caraways or some powdered ginger, and make the whole into a paste with a sufficiency of the bran-flour. Divide the mass into seven equal parts, and bake each separately in a saucer by rather a quick oven; time about twenty minutes. Another way is to take potatoes, 4 lbs.; rasp them, and wash on a sieve as above; 3 ozs. mutton suet, three eggs, 2 ozs. butter, 1 drachm carbonate of soda; mix, and add ½ fluid oz. pure *dilute* hydrochloric acid Lond. Pharm. Divide into two cakes, and bake immediately in a quick oven until nicely browned.—G. A. K.

Sulphate of Manganese.—This substance is not used in the arts or manufactures to any extent; those who want it (as for instance calico-printers) either make it themselves or purchase it from manufacturing chemists, who only make it in any quantity when ordered; as to its price, any price-list of wholesale firms will give information.—L.

Carbonic Acid.—Carbonate of barium is by no means a mineral found in such quantities as to render it particularly adapted to the manufacture of carbonic acid on account of cheapness as compared with white marble, thousands upon thousands of tons of which, in the shape of chips, are burned for lime; and which, in small quantities, at stone-masons' and marble-work yards, may be had almost for the mere trouble of picking them up.—A.

Magnesian Cement.—I have been trying the magnesian cement—an oxychloride of magnesium—discovered by M. Sorel, of Paris, and am struck with its cementive powers, even when mixed with much foreign matter. An invention apparently so excellent can hardly have been allowed to remain unnoticed without some reason. Are its hydraulic properties deficient? Are the materials too expensive for application on a large scale?—R.

Black Ink from Elder Berries.—The bruised berries are placed in an earthen vessel, and kept in a warm place for three days, then pressed out and filtered. The filtered juice is of such an intense dark colour that it takes 200 parts of water to reduce it to the shade of dark red wine. Add to 12½ quarts of this filtered juice 1 oz. of sulphate of iron and the same quantity of crude pyroligneous acid; and an ink is prepared which, when first used, has a violet colour, but when dry is indigo-blue black. This ink is superior in many respects to that prepared with galls; it does not become thick so soon, it flows easier from the pen without gumming, and, in writing, the letters do not run into one another.—*Deutsche Ind. Zeitung.*

Oxychlorides.—The white precipitate, given by $BiCl_3$ in water is called an *oxychloride* by certain chemical writers (Bence Jones, H. Watts), whilst that given by $SbCl_3$ is called a compound of the trioxide and trichloride. Is not the one as much a compound of the trioxide, &c., as the other? Chemistry aims at being exact, and certainly needs it. Why not be exact in minor matters if possible? Could the first be given as in the following equation:—

$$3(BiCl_3)+3(H_2O)=BiCl_3+Bi_2O_3+6HCl,$$

and the second—

$$3(SbCl_3)+3(H_2O)=SbCl_3+Sb_2O_3+6HCl,$$

or could not both terms be got quit of, and these precipitates be classified under the basic salts?—JOHN D. MACDONALD, Urquhart, Inverness.

Wood Pulp.—According to M. Ouvli, who has thoroughly investigated this subject, excellent results are obtained when for a hundredweight of wood pulp from 400 to 800 grms. of oxalic acid are used; this acid has the double advantage of bleaching the colouring matter already oxidised, and of neutralising the alkaline principles which favour such oxidation. He adds to the oxalic acid one pound, or a little more, of sulphate of alumina (not alum) entirely deprived of iron. The principal agent in this mode of bleaching is the oxalic acid, the power of which over vegetable colouring matter is well known; the sulphate of alumina has no bleaching power of its own, but it forms with the colouring matter of the wood an almost colourless lake, which has the effect of increasing the brilliancy of the pulp. Chlorine, chloride of lime, and any other mineral acids are decidedly injurious in the bleaching of all matters of this kind, and always leave a more or less deep yellow tinge.

Naphthaline Colours.—The discovery of fuchsine, and other colours derived from aniline, first caused the existence of very rich sources of colouring matters to be predicted in mineral oils and carburet of hydrogen in general. Therefore, since that period, chemists have devoted themselves to laborious researches in the same direction, in order to find new dycing products. The method which M. Clavel has adopted, was suggested by the study of the circumstances which have since been explained respecting the formation of fuchsine. It is now, in fact, known that commercial aniline is a mixture of aniline and toluidine, and M. Hofmann has proved that it is a mixture of these two bases that produces the brilliant colour. Guided by the examination of these facts, M. Clavel has not sought in naphthylamine for a colouring matter by itself, but one likely to produce the colour by a mixture with another base, like naphthylamine, which has served to produce it, or with any other isomeric substance. The new colouring matter, then, is obtained by the direct oxidation of a product isomeric with naphthylamine, which is procured by distilling crude naphthylamine, produced by the reduction of nitro-naphthaline, and taking the products of higher distillation to mix with the naphthylamine. The dye obtained differs entirely from the colours extracted up to the present time from naphthylamine. We will describe, in a few words, the mode of operation:—The naphthaline being first treated with nitric acid of 1·33°, the resulting nitro-naphthaline is washed, and reduced, either by iron and acetic acid, or zinc and hydrochloric acid, or any other analogous means, so as to obtain a sufficient reduction; this reduction being made, distillation is proceeded with. In the first place, naphthylamine passes; the condensation is then easier; the fire is increased, and it is then that the second body, discovered by M. Clavel, presents itself. This body constitutes the generating matter; it is treated at 120° with 50 per cent of very dry nitrate of mercury; a quantity of naphthylamine, equal to the quantity of the body used, is then added, and left in contact for about a quarter of an hour; the mixture is then treated with boiling water containing a vegetable acid; the colouring matter is dissolved, and filtered to separate the crude matters. The solution thus obtained may be treated according to the ordinary methods, for instance, by means of a salt, the colouring matter will be separated form it; this dissolved in alcohol gives a red colour of a magnificent tone, finer and more solid than the colours now extracted from naphthaline and naphthylamine; it presents by itself on the threads or tissues of silk, tints with brilliant reflection, warmer and of a clear effect. Hitherto the nature of the body discovered has not yet been specified by the author; he is waiting to give the analysis and chemical composition of it; but we can already give the principal characters of the new product. This body, which passes at the higher distillation, distils at a temperature of about 300°; its vapours form, in condensing, a deposit which rapidly becomes brown on exposure to the air. In a state of purity it is solid below 15°; it has then a viscous appearance, similar to the consistence of butter; it becomes more liquid at a higher temperature.—*Moniteur Scientifique.*

MEETINGS FOR THE WEEK.

TUESDAY, June 1st.—Royal Institution, 3. Professor Grant, "On Stellar Astronomy."
THURSDAY, 3rd.—Royal Institution, 3. Professor Tyndall, "On Light,"
—— Royal, 8.30.
—— Chemical, 8.
—— Royal Society Club, 6.
FRIDAY, 4th.—Royal Institution, 8. Prof. Odling, "On the Simplest Organic Compounds."
—— Geologist's Association, 8.
SATURDAY, 5th.—Royal Institution, 3. Mr. Deutsch, "On Semitic Culture."

TO CORRESPONDENTS.

ERRATUM.—Page 239, No. 493, column 2, line 31 from bottom, in the article "Purifying Water," for 4-10*ths* read 4 *per cent.*

M. P. Muir.—The process was fully described at the Chemical Society last session.

J. Lee, who enquires about aniline black, is referred to our Notes and Queries column.

H. K. L.—It would be obviously unfair to admit in these columns queries which are only of personal interest. These should properly be inserted in our advertising columns.

Jamie.—The book can be supplied on application to our publisher.

Communications have been received from J. Lee; P. M. Muir; W. Longworth; C. R. C. Tichborne; Professor Gunning (Amsterdam); F. Smith; W. H. Hancock; W. H. Perkin, F.R.S.; F. Field, F.R.S.; H. S. Ellis; J. C. Bowring; R. Kirwan; Dr. Lawson; T. Hill; M. Fletcher; E. Britten; Messrs. Townsend and Adams; J. Mercer; W. A. Todd; J. Davis; Griffiths, Bettison, and Co.; A. Jones (with enclosure); E. G. Tosh; W. Wyles; D. Brown; J. Kempster; W. Baxter; and J. J. Griffin and Sons.

BOOKS RECEIVED.

Cyclopædic Science; simplified by J. H. Pepper, F.C.S., Professor of Chemistry at the Royal Polytechnic Institution; with 600 illustrations. London: Frederick Warne and Co. New York: Scribner, Welford, and Co.

The American Journal of Obstetrics and Diseases of Women and Children; May, 1868, and May, 1869. Edited by E. Noeggerath, M.D., and B. F. Dawson, M.D. New York: W. A. Townsend and Adams. London: Sampson Low and Marston. Paris: J. B. Baillière.

NEW WORK BY DR. W. ODLING, F.R.S.

Just published, in crown 8vo., Price 4s. 6d., cloth,

Six Lectures on the Chemical Changes of Carbon, delivered before a Juvenile Auditory at the Royal Institution of Great Britain. By WILLIAM ODLING, M.B., F.R.S., Fullerian Professor of Chemistry, Royal Institution. Reprinted from the CHEMICAL NEWS, with Notes by WILLIAM CROOKES, F.R.S., &c.

London: Longmans, Green, and Co., Paternoster Row.

MATRICULATION AND SCIENCE EXAMINATIONS, UNIVERSITY OF LONDON.

Arithmetical Exercises for Chemical Students, by C. J. WOODWARD, B.Sc., consisting of Problems and Worked Examples in the subjects of Specific Gravity, Metric System of Weights and Measures, Calculation of Formulæ from Percentage Composition, the Crith and its Uses, Thermal Units, &c.

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Just published, demy 8vo., price 6d.

On English and Foreign Alkalimetrical and Chlorimetrical Degrees, by John Pattinson, F.C.S. Read before the Newcastle Chemical Society.

London: CHEMICAL NEWS Office, Boy Court, Ludgate Hill, E.C.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By THOMAS RICHARDSON and HENRY WATTS. Second Edition, illustrated with numerous Wood Engravings.

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Vol. III., on Food, Sugar, &c., is at present out of print.

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The Session 1868—1869 will commence on the 1st of October, when Mr. BRAITHWAITE'S Laboratory, which has been enlarged, will be re-opened at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS meets as usual every Monday and Thursday Evening, at 8 p.m., commencing October 1st.

The LATIN CLASS for the reading of the Pharmacopœia, Physicians' Prescriptions, &c., every Tuesday and Friday Evening, at 8 p.m., commencing October 2nd.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday Evening, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday until further notice.

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Mr. Braithwaite receives a few Pupils to board in his house.

THE CHEMICAL NEWS.

VOL. XIX. No. 496.

RESEARCHES ON TURACINE,

AN ANIMAL PIGMENT CONTAINING COPPER.*

By A. H. CHURCH, M.A. Oxon.,
Professor of Chemistry in the Royal Agricultural College, Cirencester.

FROM four species of *Touraco*, or plantain-eater, the author has extracted a remarkable red pigment. It occurs in about fifteen of the primary and secondary pinion feathers of the birds in question, and may be extracted by a dilute alkaline solution, and re-precipitated without change by an acid. It is distinguished from all other natural pigments yet isolated, by the presence of 5·9 per cent of copper, which cannot be removed without the destruction of the colouring matter itself. The author proposes the name *turacine* for this pigment. The spectrum of turacine shows two black absorption bands, similar to those of scarlet cruorine; turacine, however, differs from cruorine in many particulars. It exhibits great constancy of composition, even when derived from different genera and species of plantain-eater; as, for example, the *Musophaga violacea*, the *Corythaix alba-cristata*, and the *C. porphyreolopha*.

CONTRIBUTIONS TO ANALYTICAL CHEMISTRY.†

By DR. E. FLEISCHER, of Dresden.

ON THE EMPLOYMENT OF CONSTANT FACTORS IN THE CALCULATION OF INDIRECT ANALYSES.

IN the calculation of indirect analyses, it is of the highest importance that a factor should be found which, when multiplied by the weight of one of the substances to be estimated, gives the weight of the other. For the determination of this factor, the rule is to form two equations, expressing the relations of the atomic weights of the substances in question from different points of view. These constant factors may, however, be obtained more quickly and simply, without the assistance of equations, by the following method, which, besides facilitating calculation, is capable of employment by persons not sufficiently versed in mathematics to solve common equations.

Suppose two substances, X and Y, each of which is chemically combined with an acid or base: these two salts may be expressed by the common formula (X+C)+(Y+C); and consider the collective weight of these two compounds, which is found, by directly weighing, as equal to G. If we now assume that base or acid (to whichever the substances X and Y may be combined) is determined by analysis, and that this amount is represented by the weight C, X and Y will be the two substances to be found by calculation, and of which nothing further than their atomic weight is known.

Now, proceed as follows. First calculate what the weight of this salt would be if C were combined with the body X, having a smaller atomic weight than Y. Deduct this weight, which I will call g, from the collective weight of the two salts, which was G, and multiply the remainder by the constant factor S; the product will then be either $(G-g)\,S=Y$, or equal to the weight of the one substance, possessing the highest atomic weight which was to be indirectly found. The weight of X is obtained quite simply by deducting the sum Y+C from the collective weight G.

The determination of the constant factor ϕ is easily effected in the following manner. Suppose the two salts X+C and Y+C to be mixed together in the ratio of equal atomic weights, and add their atomic weights together. From this amount subtract the doubled atomic weight of the salt X+C (supposing X to be larger than Y), and divide the remainder by the atomic weight of Y; the quotient will then be the required constant factor for the case in point. Two examples in figures may, perhaps, render this mode of calculation more clear. The amount of K and Na contained in a weighed mixture of chloride of potassium and chloride of sodium is to be determined, the collective amount of chlorine having been ascertained in the volumetric mode, by means of a solution of standard silver; the required factor ϕ is then found as follows:—

	1 equiv. K Cl =	74·6
	+1 „ Na Cl =	58·5
Hence—1 equiv. KCl + 1 equiv. Na Cl =		133·1
When deducting—	2 „ Na Cl =	117·0
A remainder is left of—		16·1

This remainder of 16·1, divided into the atomic weight of K = 39·1, gives, as a constant factor,—

$$\phi = \frac{39{\cdot}1}{16{\cdot}1} = 2{\cdot}4285.$$

Let us suppose that the united weights of chloride of potassium and chloride of sodium amount together, in a given case, to 1·916 grms., while the total amount of chlorine found weighs, when calculated as chloride of sodium, 1·755 grms. The difference between these two weights will then be—

1·916 grms.	
−1·755 „	
0·161	

This remainder of 0·161 grms. gives, when multiplied by the constant factor 2·4285, the amount of potassium 0·390988 grms., or, in round numbers, 0·391 grms. of potassium. This weight, and the ascertained total of chlorine, *viz.*, 1·065 grms., deducted from the weight of both salts = 1·916 grms., gives 1·916 − 1·065 − 0·391 = 0·460 grms. of sodium.*

Let us take as our second example the estimation of chlorine, bromine, and iodine, in combination, by a solution of nitrate of silver. Several simple methods of effecting this are known. Among them is one I would especially recommend, in which the iodine is separately estimated, by distillation with sesquichloride of iron, or by precipitation as subiodide of copper; while the amount of silver required for precipitating the three silver compounds is determined by subsequently ascertaining the silver contained in the filtrate, and deducting it from the measured testing solution employed. This method is preferable, because one weighing of the chloride, bromide, and iodide, of silver, with the addition of the iodine already found, and the ascertained quantity of silver, suffices to calculate the weight of the three halogens where several weighings would be required.

I have intentionally chosen the most complicated method of calculation, in which the directions are as follows:—Weigh the amount of precipitated chloride, iodide, and bromide of silver, then transform all the chloride into bromide of silver by a lengthy digestion with bromide of potassium (which must be quite free from iodine), weigh the precipitate, which will now consist of only bromide and iodide of silver, and digest the weighed precipitate with iodide of potassium, whereby all the bromide of silver is changed into iodide, and the precipitate, which is to be again weighed, will contain merely silver and iodine.

* Abstract of a paper read before the Royal Society, May 27th, 1869.

† Communicated by the Author.

* The potassium and sodium contained in the mixed salts are therefore found by calculation.

It will be perceived that the last weighing of the iodide of silver only serves to ascertain the total amount of silver which is contained in all the precipitates: if this be known, the transformation of the bromiodide of silver into iodide of silver by iodide of potassium can, of course, be omitted, and also the third weighing. Thus we have here determined the amount of silver which was combined with the three halogens, chlorine, bromine, and iodine. The same amount of silver was also contained in the precipitate of bromiodide of silver. We will now calculate the constant factor for these two combinations in the following way:—

	1 equiv. AgBr = ...	188
+	1 „ AgI = ...	235
	1 equiv. AgBr + 1 equiv. AgI =	423
Thence deducting—	2 „ AgBr = ...	376
Gives as remainder—		47

If we divide 127, the atomic weight of iodine, by the remainder, 47, the constant factor between bromide and iodide of silver will be—

$$\phi = \frac{127}{47} = 2{\cdot}7021$$

The factor between chloride and bromide of silver, which is also required, is calculated in a similar manner—

	AgCl = ...	143·5
	AgBr = ...	188·0
	AgCl + AgBr =	331·5
Hence—	2 AgCl = ...	287·0

And 80 Br, divided by the remainder, 44·5, gives—

$$\phi \; 1 = \frac{80}{44{\cdot}5} = 1{\cdot}7977$$

as the factor between AgCl and AgBr.

Let us now suppose the weight of the third deposit to amount to 1·645 grms.; its proportion of silver (similar to that in the other deposits) will therefore amount to 0·756 grms.; and, supposing the weight of the iodide and bromide of silver (the second precipitate) to be 1·363 grms., the amount of iodine may be calculated as follows:—

The weight of AgI + AgBr was—	1·363 grms.
Thence deducting the amount of AgBr which corresponds to the weight of silver of 0·736 grms., namely—.	= 1·316
The remainder of—	0·047

multiplied by the factor ϕ for iodide and bromide of silver, 2·7021, gives—

$$0{\cdot}047 \times 2{\cdot}7021 = 0{\cdot}1269987 \text{ grms. of iodine.}$$

Let us assume that the weight of the first precipitate of chloride, bromide, and iodide of silver amounts to 1·185 grms.; there will then remain, after deducting the amount of Ag corresponding to the iodine found,

	1·185 grms.
−	0·235 „
a remainder of—	0·950

which represents the collective weight of the chloride and bromide of silver.

Since, then, the collective weight of silver amounts to 1·756 grms., and that contained in the form of iodide of silver to 0·108 grms. (corresponding to 0·127 grms. of iodine), the weight of silver which was contained in the first deposit as AgCl and AgBr is 0·756 − 0·108 = 0·648 grm. This amount of silver, when considered as chloride of silver, gives 0·861 grm. AgCl; and this, subtracted from the weight of chloride and bromide of silver, gives—

	0·950 grm. AgClAgBr
	0·861 „ AgCl
a remainder of—	0·089

which, when multiplied by the factor between chloride and bromide of silver, $\phi = 1{\cdot}7977$, gives—

$$0{\cdot}089 + 1{\cdot}8 = 0{\cdot}160 \text{ grm. Br.}$$

Lastly, if the collective weight of silver, together with that of the iodine and bromine, be deducted from the weight of the first precipitate of chloride, bromide, and iodide of silver, the weight of the chlorine will be 1·185 − 0·756 − 0·127 − 0·160 = 0·142 grms. The substance in question contains, therefore, about 1 equiv. of iodine, 2 of bromine, and 4 of chlorine.

Indirect analyses are always very good for rapid estimations without separation, but they are specially recommended when the known methods of separation are very minute, and thefore give rise to faults; or if the amount of one body be much larger than that of the other, which renders separation more difficult.

In the succeeding description of the estimation of baryta, strontia, and lime, the convenience of indirect analysis will be specially demonstrated; and it is hoped that the mode by calculation, above explained, and which is as simple as it is quick, will no longer be disregarded.

ON THE

METHODS OF DETERMINING

THE AMOUNT OF

PRECIPITATED OR REDUCED PHOSPHATES IN ARTIFICIAL MANURES.

By JOHN HUGHES, F.C.S.

My attention has been directed to a communication from Mr. J. A. Chesshire (analytical chemist at the manure works of Messrs. Bradburn and Co., Wednesfield), published in a recent number of the CHEMICAL NEWS, in which a new method of estimating the amount of precipitated phosphates present in superphosphate and similar artificial manures is recommended, namely, that of boiling the portion insoluble in water for about half-an-hour with a solution of oxalate of ammonia, adding a few drops of oxalic acid.

I am surprised that any such process should have been recommended by a chemist, as it is an acknowledged fact that oxalate of ammonia, even in a cold solution, possesses the property of acting on insoluble phosphate of lime to an appreciable extent. Liebig has referred to this function of oxalate of ammonia when speaking of Peruvian guano, and has pointed out that this salt, which is present in guano in a variable proportion, plays an important part in rendering the insoluble phosphates to a certain extent soluble.

More recently, Dr. Voelcker, in a paper "On the Means of Increasing the Efficacy of Peruvian Guano" (published in the *Journal of the Agricultural Society*, 1864), has described some interesting experiments, which prove that oxalate of ammonia, which is always present, even in best Peruvian guano, has the effect of rendering the insoluble guano phosphates soluble. He found, moreover, that this effect is greater when comparatively little water is mixed with guano, and the concentrated solution of oxalate of ammonia thus produced is allowed to react for several hours upon the insoluble guano phosphates, than when much water is added, and the weak oxalate of ammonia solution is filtered off at once from the insoluble portion of the guano.

It might be urged that the peculiar solubility of a certain proportion of the phosphates in guano is probably due to the minute state of division in which they are present in this material; I have, therefore, made the following experiments with ground Cambridge coprolite, a phosphatic mineral, which is particularly hard, and which, I need hardly mention, contains no so-called "reduced" or precipitated phosphates.

Twenty grains of coprolite were boiled for about half-an-hour with 4 ounces of a solution which contained 10 grains oxalate of ammonia and 20 drops of oxalic acid solution (strength, 1 in 30); the insoluble portion was

then removed, and the phosphoric acid in the filtrate determined as pyrophosphate of magnesia, the results being calculated as tribasic phosphate of lime. A second experiment was made, in which 20 grains of oxalate of ammonia were added, instead of 10 grains.

The solution (filtrate), in the

1st experiment, contained phosphoric acid 3·48 per cent
(Equal to tribasic phosphate of lime 7·61) . ,,
2nd experiment, contained phosphoric acid 4·60 per cent
(Equal to tribasic phosphate of lime 10·05) ,,

As it might appear that free oxalic acid was the principal agent in rendering the coprolite phosphates soluble, I made another experiment, in which oxalate of ammonia alone was employed.

Twenty grains of coprolite powder, 40 grains oxalate of ammonia, and 4 ounces of water were digested for half-an-hour, and the solution subsequently treated in precisely the same way as before.

In this experiment, I found in the filtrate—

Phosphoric acid.. .. .. 5·38 per cent
(Equal to tribasic phosphate of lime 11·75) ,,

It will be seen that oxalate of ammonia acts with considerable energy upon hard mineral phosphates; it is natural, therefore, to suppose that it will render soluble the insoluble phosphates frequently present in artificial manures, in the shape of bone or bone-ash, to a greater extent than it will hard mineral phosphates.

Your correspondent assumes that the plan of boiling out the insoluble portion of a manure with citric acid, is the one now generally employed in estimating the amount of precipitated phosphates, but I do not know any laboratory in which this practice prevails; at all events, the citric acid plan has been found impracticable in Dr. Voelcker's laboratory, where I am engaged at present.

Recently-precipitated phosphates, unquestionably, are more valuable than raw mineral phosphates; still, it cannot be maintained that they are as efficacious and valuable as phosphates actually soluble in water.

As long as we cannot separate with accuracy precipitated from ordinary insoluble phosphates, it is certainly objectionable to introduce into analytical statements the term "precipitated" or "reduced" phosphates.

There is no difficulty in broadly distinguishing between phosphates actually soluble in water and phosphates insoluble in water; and it appears to me desirable to adhere to the present plan of guaranteeing the quality of mineral superphosphates—by stating the percentage of soluble and insoluble phosphates which they contain.

ON THE

FUNCTIONS OF NUCLEI

WITH RESPECT TO GASEOUS, SALINE, AND VAPOROUS SOLUTIONS.*

By CHARLES TOMLINSON, F.R.S., F.C.S.

As every one here present is engaged in conducting processes in chemistry and pharmacy, you will, I am sure, be interested in some new experiments connected with the solution of gases, crystallisation, ebullition, and distillation, which I shall have the honour of performing before you.

You know that when a bottle of soda-water is emptied into a glass, there is not only an escape of gas from the surface of the liquid, but innumerable bubbles become attached to the inner surface of the glass. A crumb of bread, thrown into the soda-water, produces a lively effervescence; and, if we put into it the finger, a strip of paper, a rod of glass, of metal, or of wood, it immediately becomes covered with gas. In fact, any solid acts as a *nucleus* in separating gas from solution; and I would define a nucleus as a body that has a stronger adhesion for the gas of a solution than for the water which holds the gas in solution.

Let us now take a glass that has been made chemically clean by being washed out with strong sulphuric acid, or caustic alkali, and copious rinsing with clean water. If the soda-water be poured into this, the results are very different. After the first effervescence is over, the glass looks as if it were full of pure distilled water, not a bubble of gas is to be seen adhering to the sides, and there is no appearance of gas any where about it. I plunge into the liquid a glass rod that has been made chemically clean, or *catharised* as it may be called: there is no escape of gas, not a single bubble adheres to the glass rod. I put in clean iron filings: there is no liberation of gas. I pour some iron filings into my hand, and rub them about, and, on putting these into the soda-water, there is a furious, boiling effervescence.

Hence, you see, there is a marked distinction between a clean or *catharised* body, and an unclean body, or *nucleus* as it may be called.

The action of nuclei may be similarly traced in the case of certain salts that form supersaturated solutions. For example, 100 parts of water, at 212° F., will take up 357¼ parts of potash alum; whereas, at 32°, the water will take up only 3·9 parts, and yet the solution, saturated at 212°, may be cooled down to 32°, without any separation of the salt, provided the vessel containing it be chemically clean, the solution clean, and means be taken to exclude the dust of the air. Such a solution is said to be *supersaturated*, because it holds more salt in solution than it can take up at the reduced temperature. In the case before us, a solution of alum, saturated at 212°, and cooled down to 32°, contains 90 times more salt in solution than it can take up at 32°. Here is a solution of alum, saturated at 194°, and containing 53 times more salt than the water, at 32°, can take up. You see it is a perfectly clear and bright solution, and may be shaken with impunity. It remains liquid and supersaturated simply because there is no nucleus to start the act of crystallisation. I take out the plug of cotton-wool from the flask; and you see how beautifully the surface of the solution becomes covered with a crystalline crust, while well-shaped octahedra grow downwards, until the whole mass is solid, and the flask quite warm from the heat developed by the change of state.

Here is a supersaturated solution of sodic sulphate in a narrow-necked flask. I take out the cotton-wool, and the solution does not crystallise; I touch the surface of the solution with a glass rod, and crystallisation instantly sets in.

Here are similar solutions of sodic sulphate and sodic acetate, each containing a solid, such as a bit of charcoal, of pumice-stone, of meerschaum, of coke, &c. These bodies, which would act as nuclei in inducing crystallisation if put into the cold solution, become inactive if boiled up with the solution, and allowed to cool down with it and in it; they are, in fact, chemically clean. I take the cotton-wool out of these flasks; some of the solutions will crystallise on the instant, others after a short time, others, again, after some hours. It depends very much on the size of the opening whether a speck of dust enter the flask; for, of course, the wider the opening, the more likely is it for the dust to find an entrance.

In the case of saline solutions, a nucleus may be defined as a body that has a stronger attraction for the salt of a solution than for the liquid which holds it in solution.

In general, a body that has been exposed to the air, or handled, or wiped with a cloth that has been handled, is covered with an oily, fatty, or greasy film, to which the water of the solution adheres either not at all, or less strongly than does the salt of the solution, and, hence, such a body introduced into the solution, acts as a nucleus. Make the body chemically clean, and the solution adheres to it as a whole; that is, there is the same amount of ad-

* A lecture delivered at the *conversazioné* of the Pharmaceutical Society, May 18th, 1869. Communicated, with additions and corrections, by the author.

hesion between the nucleus and the water of the solution as there is between the nucleus and the salt of the solution, and, hence, there is no separation.

An extreme case of this kind of perfect adhesion on the part of chemically-clean surfaces and the solutions, may be seen in this flask. It contains a highly-supersaturated solution of sodic sulphate, resting upon a considerable mass of the modified 7-atom salt. This, being chemically clean, does not act as a nucleus to the rest of the solution. I can shake the flask violently, so as to break up and rattle about these crystals at the bottom, and the solution does not solidify. But now, look at this: I take out the cotton-wool, and, instantly, lines of crystals, closely packed together, diverge from some point on the surface, and the whole saline contents of the flask form one solid mass.

This differential kind of action which belongs to nuclei, may also be exhibited with reference to liquids at or near the boiling point. My definition of such a liquid is, that it is a supersaturated solution of its own vapour. It is a solution of vapour, constituted like the solution of carbonic acid in water, or of sodic sulphate or of alum in water.

Such being the case, a body introduced into a liquid at or near the boiling point acts or does not act as a nucleus in separating vapour, according as it is unclean or clean. If clean, the solution adheres to it perfectly, and there is no separation of vapour; if unclean, the vapour adheres to the surface as strongly as before, but the liquid adheres less strongly, or not at all, and, hence, there is a separation of vapour on the surface of the nucleus.

Now, you are all acquainted with a very unpleasant phenomenon that often accompanies the processes of boiling and distillation. I mean the *bumping* of the vessel, or *jumping ebullition*, as it is called (*soubresauts*, in the language of French science). This is generally brought about thus:—The liquid makes the interior of the vessel chemically clean, and the solution of vapour adheres to the clean surface with great force; the temperature rises above the boiling point, until the liquid, not being able to dissolve any more vapour, a portion of the latter escapes with a burst along the line of least resistance, or towards the opening of the vessel. This upward action is accompanied by an equal reaction in a contrary direction, which tends to force the retort or flask further into the ring of the retort stand, or down upon any other support, and it is the rebound from this that causes the *soubresaut*. Now, for the purpose of preventing or mitigating this inconvenient and even dangerous action, it is the practice to introduce into the vessel certain angular or rough bodies, such as sand, pounded glass, bits of tobacco pipe, platinum, copper, &c. Such bodies have been called "promoters of vaporisation." How they act has not been explained, but it has often been noticed that they cease to act in liberating vapour after prolonged contact with the boiling liquid.

I need scarcely say that such bodies cease to act as nuclei in liberating vapour from solution as soon as they become chemically clean.

Now, here is water boiling in a clean flask with some difficulty and a disposition towards bumping. I put into the flask a pinch of sand from the sand bath, and the boiling immediately becomes soft and regular, and there is no tendency whatever to bumping.

But suppose we make the sand chemically clean, by heating it in contact with strong sulphuric acid, rinsing with water, washing with alkali, and again rinsing. Such sand, in very small quantity, in a chemically clean flask containing clean distilled water, will increase the bumping to a remarkable extent. Here is such a flask, standing over a spirit lamp. You see that it bounds up from the support with explosive force, and one wonders the flask is not shivered to pieces. The bits of glass, &c., put into a retort containing alcohol, ether, &c., soon behave in this way, for the liquid makes them, as well as the interior of the vessel, chemically clean, and, in such case, we multiply the adhesion surfaces, when what is wanted is an extension of the vapour-giving surfaces.

It is clearly wrong to employ as nuclei bodies that soon cease to act as such, supposing it were possible to find permanent nuclei. Porous bodies, such as charcoal, coke, pumice-stone, &c., perform this useful function. The same force which enables a piece of boxwood charcoal, for example, to absorb 95 times its volume of ammoniacal gas, causes the charcoal, in the midst of a hot solution of vapour to absorb vapour, and, under the continued action of heat, to give it out again, in a constant, never-ceasing flow.

Indeed, what is remarkable is the permanent action of these porous bodies. I have tried the same piece of charcoal or of coke in boiling liquids over and over again, for weeks together, and never found the vapour-giving action to flag. I have boiled these porous bodies in strong acids, washed them in alkalies, and made them in all respects chemically clean, without at all interfering with their vapour-separating action in boiling liquids. They do not act as nuclei in separating salt from solution if boiled up with it and allowed to cool in it; their peculiar function is to separate vapour from liquids, at or near the boiling point; and this they do by their capillarity. I have, in this flask, a bundle of glass capillary tubes, united like a faggot, by means of a thread in the middle. This acts vigorously in separating vapour from the liquid at the boiling point, and, even after the lamp has been removed from under the flask, the tubes continue for some time to discharge vapour from their ends.

Among the charcoals, the most efficient as a vapour nucleus is charcoal from cocoa-nut shell. This is very dense, and sinks below the surface of liquids denser than water, which is a great advantage.

It will, I think, be worth your while to come up, after the lecture, and watch closely this large flask of water, containing some pieces of cocoa-nut shell charcoal. The vapour passes off from each piece in perfect torrents, and there are these two remarkable advantages connected with the action, namely, bumping is entirely prevented, and the amount of distillate is largely increased, in some cases as much as from 30 to 50 per cent, with the same amount of heat, in the same time, as compared with the process without the use of the charcoal.

For example, methylated spirit of wine, boiling at 171° F., was distilled in a glass retort. The distillate collected in five minutes weighed 244 grains. Three or four fragments of charcoal, partly boxwood and partly cocoa-nut shell, weighing only 20 grains, were added to the retort. The distillate, in five minutes, was now 325 grains. The ratio of the results is 100 : 133·2. With 20 grains of pumice-stone, the results were as 100 : 121·7; with 20 grains of meerschaum, as 100 : 112; and with 20 grains of coke, as 100 : 107·46.

But these results are understated; for the retort contained some porous specks of iron or charcoal, which get attached to most glass vessels during the process of manufacture, and which act as powerful nuclei in separating vapour from boiling liquids. Indeed, were it not for these accidental impurities, many a chemical operation must fail from excessive bumping.

But, as I promised to make this a short lecture, I must conclude. You see that there is a harmony of action in the behaviour of nuclei with regard to gaseous, saline, and vaporous solutions; and, from this action, we get a clear view of the functions of nuclei, and also get rid of much speculation as to "molecular action," and "the mysterious action of the air," which some observers indulge in when treating of supersaturated solutions.

Westphalian Iron Pyrites.—At the Paris Exhibition of 1867 there was a single block of pyrites from the Sicilian Pyrites Company, in Westphalia, weighing 4500 kilos. This piece was sent from the neighbourhood of Altenhunden-on-the-Lenne, and the mine yields now yearly 100,000,000 kilos. of this ore, which, according to an analysis made by Dr. Fresenius, contains from 42 to 45 per cent of sulphur, from 39 to 58 per cent of iron, and 0·02 per cent of arsenic. On an average, about 43 per cent of sulphur in this ore is available for making sulphuric acid.—*Bul. de la Soc. d'Encouragement*,

A CHEMIST'S VIEW OF THE SEWAGE QUESTION.*

By EDWARD C. C. STANFORD, F.C.S.

(Continued from p. 255.)

Earth Carriage.

This subject has been already brought before you; but as its chemical aspect has not been treated, I shall briefly allude to it. Some misconception appears to have prevailed here as to the disinfecting power of dry earth and ashes; both are absorbents of moisture, and to this extent, and no further, are these disinfectants. This may be easily proved by filtering putrid urine through either of these media; it passes unchanged.

These materials are only, therefore, deodorisers when largely in excess of the fœcal matter to which they are added.

Thus to take dry clay, the best substance of the kind, it would require three and a half times as much as the excreta, or 17,500,000 cubic feet to be brought into the city, and 22,500,000 cubic feet to be taken out again; and the actual value of this product would be £208,333, or 2¼d. per cubic foot, or 6s. 7d. per ton. Its practical value would, however, be much less, because, on account of the expensive carriage, the value of a manure decreases in inverse geometrical proportion to its strength. It stands to reason, therefore, that if a dry vehicle is to be resorted to, it must be more economical to use some substance which increases, rather than diminishes, the agricultural value of the product, especially if less of it can be employed to do the same work. That substance, which, while acting as a deodoriser, also absorbed the most water for a given weight, and added its value to the product, should, theoretically, be the best for this purpose. I find that, while perfectly dry clay only absorbs 45 per cent of water, dry seaweed char absorbs 147 per cent, and the former becomes a sludgy mud, while the latter can be easily removed.

The use of an absorbent of this kind would, therefore, reduce the amount of material to be brought into the city to less than one-third, or to an amount equal to the excreta to be removed; or 5,000,000 cubic feet brought in, and 10,000,000 cubic feet taken out, annually, the daily removal being 385 tons in, and 770 tons out. This is not more than the present daily removal of ashes, while there would be no greater nuisance, and the value, exclusive of the value of the charcoal, would be about 15s. per ton. Viewed in this light, the dry closet system presents strong claims to notice, and, in a sanitary sense, its arrangements are perfect.

Air Carriage.

Carriage by atmospheric pressure possesses several advantages afforded by neither of the former systems, both of which add a large bulk of valueless, but costly, material to the excreta to be removed. Considering the great value, and easy application, of pneumatic pressure, it is remarkable that so little attention has been directed to it as a means of dealing with excreta; it has been entirely overlooked by those great authorities who have professed to look into all the bearings of this difficult question.

The principal effort in this direction is due to Captain Tiernur. I will briefly describe the main features of this proposition, referring to "The Sewage Question," by Krepp, for further details. Captain Tiernur proposes to place in houses a simple open-pan closet of a particular form, in connection with a vertical soil-pipe, and so shaped that the total excreta fall at once to the bottom of this pipe in the basement storey of the house, where it collects in a small syphon bend. The soil-pipe is made of earthenware, 14 to 16 inches in diameter, and is continued to the top of the house, where it is open to the air, and covered with a wind-guard for ventilation. The syphon bend and bottom of the pipe are of cast-iron narrowed from the soil-pipe to a 5-inch cast-iron pipe. This is continued to a central receiver, sunk in the public street. This reservoir has about 20 cubic feet capacity; and allowing 1 cubic foot to every thirty-six individuals, each serves about 700 persons and a number of houses. Each house has a so-called house-valve, which is accessible from the street, and closes the connection with the sewage reservoir. This reservoir may be placed in any central position in the public street, sunk under the ground, and surmounted by an ornamental lamp-post, within which the two communicating pipes are concealed. It is of a nearly spherical shape, or quite spherical top and bottom, with cylindrical sides. It receives the drain-pipes from a number of houses, collected in four main branches, which enter it with a slight bend at the top; the house pipes and main pipes are all about 5 inch bore, the former entering the latter horizontally at an angle of 30°, and a curve of 2 feet radius. The main pipes have a gentle downward inclination towards the reservoir, but enter it by a sudden bend upwards. There are two vertical pipes concealed within the lamp-post—one, the air-pipe, about 3 inch bore, fixed to the top of the reservoir; and the other the exit soil pipe, about 6 inch bore, continued nearly to the bottom of the reservoir.

The mode of filling and emptying these receivers is by a "locomotive engine and pneumatic tender," which is drawn by one horse, assisted by the steam power of the engine, to the several reservoirs during the night. The process is simple; the engine works a powerful air-pump, which is placed in connection with the reservoir and the tender; in about three minutes the gauge indicates a vacuum of about 10 lbs. to the square inch, or about 20 in. barometer pressure, and both are sufficiently exhausted. The several house-valves are then opened and closed consecutively, and the contents of the syphons instantly shot into the receiver by the downward pressure of air in the soil-pipe, the vertical ventilating shaft acting like a pea-shooter. When all the house-traps are discharged, the air-pipe of the receiver is disconnected, the exit soil-pipe connected with the exhausted tender, the contents thus transferred to it, and the whole machine is driven off to the next reservoir; the foul gas from the air-pump is blown into the engine furnace. The tenders have each 100 cubic feet capacity, 10 cubic feet of which is used as a water-tank to the engine. When full, these are taken to "decanting houses," where the contents are transferred to barrels. These barrels are 28 inches in diameter, 32 inches long, about 5 cubic feet capacity, and made of strong oak staves bound with iron hoops; they form the stores for the manure, and for its transport, and are to be sold direct to farmers. For applying the contents directly to the soil, which is Captain Tiernur's special object, he proposes plans of ingenious manure ploughs and meadow manurers, which support the barrel and empty its contents at once into the furrow, where it is covered over and kept at once from decomposition. During frost, he proposes keeping these barrels in store.

The method of collecting, and particularly of applying, the excreta in these barrels, seems to me a most unnecessary complication. Glasgow would collect at the rate of 2,740 barrels a day, and a month's frost would accumulate an explosive store of 82,000 barrels; while in the summer I fear the barrels could not be used fast enough to prevent decomposition. There is also this great objection to this method, which applies, also, to irrigation, that we are compelled to sell our manure constantly to get it off our hands, and by making the farmer take it when he does not want it, and cannot advantageously apply it, we are entirely at his mercy, and must accept his prices; but if we could store it, make it into good manure, and sell it when he wants it, then, and not till then, can we expect to realise its value. If the other parts of this plan work well, a modification would make this feasible.

* Read before the Glasgow Sewage Association, March 30th, 1869.

We have a material to deal with in chemical works which presents some analogy with that under consideration; it must be kept from the air, it cannot be handled; but it is nearly double the weight of the excreta, and very corrosive. Yet this is lifted, without any difficulty, to great heights, and carried long distances, with no trouble and little expense, by atmospheric pressure; and could not the excreta be dealt with in the same way? The drain-pipes from the houses should be led into iron reservoirs, the size and number of these to be determined; the total daily removal being only 13,700 cubic feet, twelve cylindrical boilers with egg-shaped ends, about 10′ × 10′, by 15 to 20 feet long, sunk vertically, would be sufficient for Glasgow. It might, however, be advisable to have smaller vessels in larger number; that is a matter of detail.

These reservoirs are all to be connected, by a small air-pipe, to one or more central pumping stations, where a powerful air-pump is fixed; each, also, to be furnished with an exit soil pipe, passing to the bottom, and continued up into a main pipe leading to one or two manure works situated some miles out of town.

This would, then, be the process of removal; at a fixed hour at night the air-pump would be set to exhaust a large iron reservoir at the pumping station, and communicating with the air pipes attached to the soil reservoirs. Two men for each district would then be sent round, and, opening the air-pipe valve, would place each receiver in connection with the exhausting pump, and then open, consecutively, the house-valves, by which means the soil-pipes would be nightly discharged, and the whole closet ventilated by a powerful blast of air. This is one operation. During the day, at a certain hour, the engine and air-pump would be reversed, and pump air into the air-vessel at the pumping station; the several soil reservoirs would then be placed in connection, and the contents lifted, by the atmospheric pressure, away to the manure works.

When we consider that a pressure of 50 lbs. on the square inch can be thus easily applied, there is merely the friction and some little weight to overcome; the plan seems quite practicable, and is, at any rate, worth a trial. The piping required would be an arterial system of small cast-iron piping; its cost, compared to sewers, would be little, and the cost for pumping must be insignificant, compared to that for lifting sewage in such enormous quantities.

The Abbey Mills pumping station has eight engines, 142 horse power each, or 11·36 horse power; and these lift 15,000 cubic feet a minute 36 feet high. We have only to lift 385 tons, or 13,700 cubic feet, and the whole day's produce of Glasgow may be contained in a tank 30 feet square and 16 feet deep. These pumps, therefore, would do our day's work in fifty-four seconds.

When engineer's talk of intercepting sewers for our sewage, they mean immense culverts of brick, which leak in all directions, and are full of noxious gases, to carry off 137,000 tons of sewage a day, containing 385 tons, or 1-355th of excreta, and only 38½ tons, or 1-3550th of its weight, of solid excreta. My notion of a true intercepting sewer is a perfectly tight and cheap cast-iron pipe, which will really intercept this excreta, and deal with it alone. It is, to all intents and purposes, a fluid, and subject to all the laws of fluid pressure; to add 355 times its weight of water to *make it fluid*, is not only "carting coals to Newcastle," but it is paying very heavily for the pleasure of doing so.

Engineers should consider the possibility of removing, without nuisance, the excreta, as it is, from where it is to where it should be; because, if it can be so delivered, the further disposal of it can be safely left to chemists, who may, then, be fairly asked to turn it to account. We have not hitherto had a fair chance; engineers are allowed to mix the excreta with much water, and then to turn round and ask chemists to separate it again, forgetting that the "*reductio ad absurdum*" is *not* a chemica process.

Dickens, in his preface to the last edition of "Pickwick Papers," after referring to the great improvements which have taken place since he wrote the work, ventures a hope that "it may some day be discovered that the universal diffusion of common decency and health is as much the right of the poorest of the poor as it is indispensable to the safety of the rich and of the state; that a few petty boards and bodies—less than drops in the great ocean of humanity which roars around them—are not for ever to let loose fever and consumption on God's creatures at their will, or always to keep their jobbing little fiddles going for a dance of death."

DECOMPOSITION OF REFRACTORY SILICATES BY FLUORIDES IN THE WET WAY.

By CHARLES E. AVERY,
Student in the Massachusetts Institute of Technology.

I FIND that silica and silicates, such as felspar and glass, may be completely dissolved in the cold by a mixture of some normal fluoride with almost any of the stronger acids, whether concentrated or dilute.

When mixed with the fluorides of sodium, barium, aluminum, lead, or the double fluorides of these metals, the silicates in question can be readily decomposed by nitric, chlorhydric and sulphuric acids, either concentrated or diluted with four volumes of water.

If strong sulphuric acid is used, a part of the silicon passes off as gas; if the dilute acid is used, portions of many silicates remain undissolved as insoluble sulphates.

The same decomposition of the silicates is effected, though less easily by the action of oxalic, acetic, tartaric, and like acids, on the mixed fluoride and silicate. Carbonic acid, even as dilute as in the air, does the same thing, but less rapidly.

Strong nitric acid gives a perfect solution and acts rapidly, dissolving a moderately fine powder of felspar or quartz in a few hours even in the cold. The loss of silica is very slight if the experiment is properly conducted; hence, all the constituents of a siliceous mineral can be estimated in the solution produced.

In analysing the silicates in this way, it is best to use the fluoride of some metal which is not to be estimated in the analysis; since, if we use a fluoride whose metal is present in the mineral, we must know the weight of fluoride taken. Of the various fluorides those of barium and lead seem to me the most promising.

An objection to the use of fluoride of ammonium is that, as usually made, it contains sulphate of ammonium, so that insoluble sulphates might be formed and solution retarded.

If fluoride of sodium, as made from cryolite, were not so hard to purify, it would be well fitted for the analysis of silicates free from sodium.

It has long been known that acid fluorides attack the silicates, and that even acetic acid can change normal into acid fluorides; but, so far as I know, no one has before shown that the action of acids is sufficiently rapid and complete, in the cold, to be useful in analysis. In another paper, I shall give the details of the process of solution, the method of analysis, and the means of making the fluorides.

Boston, February, 1869.

Quantitative Estimation of Sulphocyanides.—According to experiments instituted by Dr. Rüdorff, the estimation of the aforenamed salts, when neutral and soluble in water, is perfectly reliable when executed by means of titration with a neutral soluble silver salt. Experiments made by the author with properly re-crystallised sulphocyanides of ammonium and potassium yielded exactly the theoretical quantity; the salts experimented with had been purified by re-crystallisation from alcohol and afterwards drying.—*Poggendorff's Annalen.*

NOTICES OF BOOKS.

More Light: A Dream in Science. Wyman and Sons, Great Queen Street, Lincoln's Inn Fields.

IN the so-called "scientific world" we find a large number of men who do not work. The reasons why they do not work are not always so obvious as one would imagine. Some, including among them many of our most influential and successful men, do not work simply because they find it unnecessary. Fluent, strong in voice and in nerve; ambitious, and, perhaps, just the least thing in the world intriguing, they find it far more easy to acquire a position in scientific societies by criticising the researches of others than by working themselves. It is men like these who so mercilessly cross-examine the laborious workers who venture to read their papers before scientific bodies. These cross-examinations are, moreover, often carried on in a semi-bantering tone, as if the student had taken a liberty in bringing his results before a body, some of whose most august members found work unnecessary. And how often, in all countries, do we find the mantles of the greatest workers placed on the shoulders of these very men!

On the other hand, a vast number of those we meet in scientific circles do not work, simply because they prefer to dream. As there are people (even in this our day) who buy works on witchcraft and alchemy, not as curiosities, to be laid on the shelf until wanted as illustrations of the history of a past age, but to read them with reverence and faith, so there are men who revel in any darkness that has a savour of mystery. They have an instinctive repugnance of those physical truths which can be demonstrated by an appeal to the balance; as we have said, they prefer to dream; but we must do them the justice to say they generally keep their dreams to themselves. The author of the pamphlet before us is a man of a different stamp; he publishes his dreams, charges one-and-sixpence for them, and, fearful that his just rights and property in his dreams will be infringed, he carefully reserves the right of translating them. This is wrong. When a great prophet comes to give us "more light" (and we confess that we need it), he should rather encourage than repress those who would disseminate it.

But, to proceed—It was on a winter's evening, in December, 1866, that our author sat by the fire reading, to relax what he is pleased to term "his mind," which had been for several hours absorbed in "abstruse scientific speculations." The book that he read was George Henry Lewes's "Life of Goethe." As he read his last memorable words, "More light!" and pondered upon their depth of meaning, he fell asleep. What then happened he does not tell us; but a mysterious line of asterisks at once informs us that it was something very awful. Soon there appeared at his right hand a man, "beautiful of countenance." On his brow was a band, on which appeared, in sparkling gems, the name "Oriel," "Light of God;" and in his right hand he held a rod. Our author here pathetically tells us that he "trembled." This was but natural; he probably feared that Oriel was about to lay it on. Oriel, however (who, althongh a highly rectified spirit, appears to disagree with the stomach or brain of the eminently dyspeptic dreamer), bids him not be afraid, and, good-naturedly taking him by the hand, places him on a "Pinnacle of the Universe."

Oriel then tells him the destiny of the sun, and explains a few other astronomical phenomena, in language which shows distinctly that he has read Herschel's "Astronomy," and that his reading has been for edification. Our author (doubtless because Oriel has laid aside his rod) now not only ceases to "tremble," or to be "afraid," but even summons up courage enough to put a regular poser to Oriel in these startling words—"What is matter?" Oriel, evidently at a nonplus for the moment, does exactly what we all do under similar circumstances, and, instead of answering the question, proposes another, namely, "What is mind?" If our author had been sharp, here was a capital opportunity for a repartee. He should have answered "It is *no matter*;" but, instead of this, he somewhat feebly gives the views of Newton and Bishop Berkeley. Afterwards, feeling that he is expected to quote some more modern philosopher, he states "matter to be nothing but force, thus depriving it of that grossness generally supposed to belong to it." This, he says, "was the opinion of Faraday, who could not prove it, but yet believed it not impossible."

Poor Oriel, feeling himself unable to oppose the views of Faraday, without losing the confidence of our Dreamer, then states his own views to be the same. We would here most respectfully put the following difficulty which occurs to us, to Oriel. If you say that matter is force, we hope you will admit that force is matter; and, therefore, if, by out-flanking the question, in endeavouring to *take* grossness from matter, do you not at the same time *give* grossness to force? We do not insist upon this argument, because we feel, with Sir Roger de Coverley, "that much may be said on both sides."

Oriel then goes on to show our Dreamer (let us here confess that we had very nearly omitted the capital D) the "original element," and to prove that "this original element" is, "paradoxical as it may seem, *nothing*."

Up to this point we had travelled in all faith with our author; but when we find him gravely state that Oriel's next step was to make this "original element" (which he admits to be Nothing) revolve on its axis, we gave it up. We do not wonder, then, that after a few more feats, which Robert Houdin might have studied with advantage, our author says, "Despair took hold of me; my brain began to whirl, my feet to slip from under me, when—oh! relief!—I awoke; and it was a dream." At this point, we made a great discovery. "More light" is an allegory. Oriel means spirit; as we said before, highly rectified spirit; and thus we see that, under the influence of too strong a dose of "Oriel," we may expect our brains to whirl, and our feet to slip from under us.

Pharmacopœæ Recentiores, Anglica, Gallica, Germaniæ, Helvetica, Russiæ, inter se collatæ. Scripsit, præfatus est et indicem triplicem adjecit, H. HAGER, Phil. Dr., Vratislaviæ. Günther, 1869.

THIS work will, undoubtedly, be appreciated by all really scientific medical men, as well as by pharmaceutists everywhere, and Dr. Hager deserves the greatest possible credit, and the sincere thanks of the profession for this publication. As the title indicates, he has compared, *inter se*, the pharmacopœias recently published in Great Britain, France, Germany (not to be confused with the Pharmacopœæ Borussica (Prussian), for the work here alluded to is in use in Central Germany, in dominions not as yet Prussianised), Switzerland, and, lastly, the immense Russian empire.

Throughout this work, the rule of most continental pharmacopœias, that weighing shal almost always be resorted to, instead of measuring, has been rigidly adhered to, and the measures of the British pharmacopœia have been reduced to weights as far as possible. The book is alphabetically arranged, and is, therefore, easy for reference.

Taking a couple of instances, almost at random, we observe, in the Russian codex only, a very excellent prescription for making magnesia sulphurosa (sulfis magnesiæ), a salt now used internally in this country. The French codex has syrupus chinini sulphurici (sirop de sulfate de quinine), a useful preparation to give to young children, if required.

There are added to the work (1st) very useful tabulated forms, taken from the Swiss and German codices, wherein are indicated the single doses of the more active preparations and compounds, *above* which the substances named should not be dispensed, *unless* the medical man who pre-

scribes *distinctly* requires higher doses to be given; (2nd) indices for reference in the French, English, and Latin languages.

The book is well printed, in clear type, by M. Günther, at Breslau.

Labels for Chemical Substances. In paper wrapper, price 6d. London: John J. Griffin and Sons, 22, Garrick Street, W.C.

In a recent number, we noticed several editions of chemical labels. We have since received another book, containing 195 labels, admirably arranged by A. Vernon Harcourt, M.A., F.R.S., Secretary to the Chemical Society, and H. G. Madan. The nomenclature is similar to that adopted in "Fownes" and "Roscoe." The labels for solutions contain an indication of the strength of the solution, and an explanation of the expressions used is also given. We are told that a book on laboratory practice, by the same authors, will shortly be issued.

CORRESPONDENCE.

EQUIVALENCE AND QUANTIVALENCE.

To the Editor of the Chemical News.

Sir,—No better proof can be wanted of the truth of Professor Williamson's remarks, upon the conflicting views held by chemists on the theories of equivalence and quantivalence, than a comparison of the opinions which those remarks have called forth.

Mr. Ward regards atomicity and quantivalence, equivalent and atomic weight, as synonymous terms. Mr. Orme describes the equivalent of an element as a varying quantity, from which the atomic weight is deduced by theoretical considerations, and from which it differs, being, of course, constant. Mr. Attfield tells us that the term equivalent is correctly used with "distinct meanings," that the equivalents of Cl, O, N, C, are 1, 2, 3, 4, "in regard to the exchangeable values of atoms" but 35½, 8, 4⅔, 3, "in displacing one part by weight of hydrogen." "Chemicus" seems to follow Wurtz in considering the term equivalence a substitute for atomicity.

Doubtless these conflicting ideas would be reconciled, and much vagueness overcome, by accepting the definitions given by Mr. Ward, but unfortunately for our peace of mind, we cannot adopt them, unless we shut our eyes to chemical phenomena and our minds to the reasoning of not less able chemists. Equivalence may justly be considered *ponderal*, but equivalent weight can scarcely be taken as synonymous with atomic weight, as Mr. Ward seems to think. Let it be for a moment considered that atoms represent forces—as may be done upon the supposition that saturated compounds are in a state of equilibrium—then we may suppose that the atom of phosphorus in such a compound as the pentachloride (PCl_5) exerts a force five times as great as one atom of chlorine, consequently $\frac{1}{5}$ will represent a force equal to that exerted by 35·5 parts by weight of chlorine, and may reasonably be said to be equivalent to it. No such equivalent relation, however, exists between 1 part by weight of hydrogen and 16 of oxygen.

The numerical nature of quantivalence or atomicity is, of course, universally granted; a difference has, however, already arisen with regard to the use of these two terms, which Mr. Ward considers as synonymous. Naquet, in his excellent "Handbook of Chemistry," has preferred using the term atomicity for the maximum amount of saturation of which an element is capable, while he reserves the term quantivalence to express its varying saturating power. Thus he speaks of lead as being tetratomic, but forming a series of compounds in which it is bivalent. If atoms represent forces, they must be definite forces, which sometimes become latent, and it seems desirable to have a special nomenclature by which the degree of latency may be expressed.

Since, then, the word atomicity is objected to by chemists (not, I think, without cause), and the expression quantivalence has a special significance, I would suggest that the term equivalent *number* be used to express the *fixed* saturating power of polyatomic bodies. If this course were adopted, we should speak of an element, such as phosphorus, as having for its

Atomic weight	31
Equivalent weight	$\frac{31}{5}$
Equivalent number	5

And as forming compounds, such as PCl_3, in which it is trivalent, and others, such as PCl_5, in which its quantivalence and equivalent number are the same.—I am, &c.,

C. H.

MISCELLANEOUS.

The Chemical Society, wishing to honour the memory of its late distinguished Fellow, Professor Faraday, and at the same time to promote the personal intercourse of the Society with eminent foreign chemists, has decided upon instituting a Faraday Medal, to be awarded, from time to time, to some foreign chemist of distinction, upon his accepting the invitation of the President and Council of the Chemical Society to deliver a lecture to its Fellows. The inaugural lecture will be delivered on June 17th by M. Dumas, Master of the French Mint, a personal friend of Professor Faraday's, and well known to chemists all over the world as the author of many important investigations in organic chemistry, and especially as the introducer of the doctrine of chlorine substitutions. By permission of the managers, M. Dumas's lecture will be delivered in the theatre of the Royal Institution, associated for so many years with Professor Faraday's own expositions. The Fellows of the Society and their friends will dine together at Willis's Rooms on June 18th, on which occasion M. Dumas is expected to be present as a guest.

Collodion for Protecting Silver Wares.—The loss of silver which results from the impregnation of our atmosphere with sulphur compounds, especially where gas is burned, is very great. It has been said that many thousands of pounds' worth go down our sewers annually in the form of dirt from plate cleaning, and the loss of one large house on Cornhill from this source has been described to us as serious. Silversmiths may, then, thank one of their confraternity—Herr Strolberger, of Munich—for a happy thought. He seems to have tried various plans to save his silver, if possible. He covered his goods with a clear white varnish, but found that it soon turned yellow in the window, and spoilt the look of his wares. Then he tried water glass (solution of silicate of potash), but this did not answer. He tried some other solutions, to no purpose; but at last he hit upon the expedient of doing his goods over with a thin coating of collodion, which he finds to answer perfectly. No more loss of silver, and no longer incessant labour in keeping it clean. The plan he adopts is this:—He first warms the articles to be coated, and then pays them carefully over with a thinnish collodion diluted with alcohol, using a wide, soft brush for the purpose. Generally, he says, it is not advisable to do them over more than once. Silver goods, he tells us, protected in this way, have been exposed in his window more than a year, and are as bright as ever, while others unprotected have become perfectly black in a few months.—*Mechanic's Magazine.*

Depth of some Recently-Bored Wells.—As an evident proof of the greatly advanced desire to procure for domestic purposes good and pure water and a plentiful supply thereof, it is interesting to learn that within the last five years the undermentioned wells have been bored, some of them at very great expense. At Antwerp, to a depth of 165 metres below the surface; at Ostend, 300 metres; at Oeynhausen, Prussia, 696 metres; at Mondorff, Grand Duchy of Luxemburg, 730 metres; at Passy, Paris, 624 metres; at Rochefort, Charente Inférieure, France, 816 metres (this is the deepest bored well now existing in Europe). At Grissee, Soerabaya, Java, a well has been bored to a depth of 549 metres through hard rock. The deepest boring in Holland has been carried to a depth of 182 metres below sea level at Gorkum, at which depth in that locality, the tertiary formation has been reached, but water only of very indifferent quality; with this exception all the above-named wells yield water in abundance, and of great purity.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we are endeavouring to effect arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

Annales des Mines, vol. 14, sixth series, No. 6.

The greater portion of this valuable periodical is filled with information of use only to the officials and officers of the Corps Impérial des Ingénieurs des Mines. We meet, however, with a large number of results of analyses of waters, among which is one, very recently made, by M. Péligot, of—

The Water of the Grenelle Artesian Well.—The author calls attention to the remarkable fact that this water does not contain any dissolved oxygen, but only nitrogen, the quantity of which amounts to 14 c.c. to the litre of the water at 10° C. The total saline residue to the litre amounts to 0·142 grm.; the percentage composition of this saline matter is:—Carbonate of lime, 40·8; carbonate of magnesia, 11·5; carbonate of potassa, 14·4; carbonate of protoxide of iron, 2·2; sulphate of soda, 11·3; hyposulphite of soda, 6·4; chloride of sodium, 6·4; silica, 7·0. The same author has estimated the quantity, and determined the quality of the gases contained in rain water fallen and collected in the neighbourhood of Paris; 1 litre of this water gave off 23 c.c. of gas composed, in 100 parts, of 2·4 parts of carbonic acid; the remainder was a mixture of oxygen and nitrogen, in the proportion of 32 parts of the former to 68 of the latter. M. Stoelet has discovered that the water brought up from the coal-pits contains a greasy matter, soluble in ether, and no doubt derived from the coal; from his observations at and about collieries, he draws the conclusion that this greasy or fatty matter makes the water unsuitable, and, at times, even dangerous, for the use of steam boilers, since it may cause explosions.

It being impossible to quote all, or even the larger portion, of the results of mineral water analysis contained in the above-named periodical, we conclude this brief notice with—

Analysis of the Water of Villa Salice, near Voghéra, Piédmont.—M. Tissandier.—The dry residue for 1 litre weighs 65·532 grms., composed of—Chloride of sodium, 61·544 grms.; chloride of calcium, 1·031; iodide of magnesium, 1·338; sulphate of lime, 0·144; carbonate of lime, 0·811; carbonate of magnesia, 0·165; silica, alumina, oxide of iron, and organic matter, 0·499; total, 65·532 grms. This water is remarkable on account of the large quantity of iodine it contains.

This number of the *Annales* contains, moreover, a valuable collection of the results of recently-made analyses of minerals and rocks from divers parts of the globe.

Bulletin Mensuel de la Société Chimique de Paris, May, 1869.

This number opens with the *extraits des procès-verbaux des séances*, from which we abstract the following:—

Urea.—M. Bouchardat communicated that he had studied the conditions which accompany the production of urea by the action of ammonia upon chloroxycarbonic acid; besides urea, cyanic amides, melanuric acid, and other substances are formed. Hydrogen, in the nascent state, attacks nitrate of urea, thereby producing divers gases, consisting of hydrogen compounds, nitrogen, and carbonic acid. This reaction may be applied to the quantitative estimation of urea, by weighing the quantity of carbonic acid given off.

Oxysulphide of Carbon.—M. Ladenburg gave an oral account of his researches on oxysulphide of carbon. This substance, first obtained by M. Than, by means of the decomposition of sulphocyanate of potassium with dilute sulphuric acid, is also the product of the action of sulphuretted hydrogen upon cyanic ether, and of the action of heat upon thiacetic acid; it is also formed when sulphide of carbon acts upon urea.

Hydrates of Hydrocyanic Acid.—M. Gautier made a few observations on the question of the existence of well-defined hydrates of hydrocyanic acid. The experiments of MM. Bussy and Buignet, on the contraction of mixtures of water and hydrocyanic acid, led to a maximum contraction, corresponding to a mixture expressed by the formula $2CNH+3H_2O$; if, M. Gautier says, there do exist hydrates, their fusing point must be constant. In order to test this, the author made several experiments on this subject, with mixtures made up of variable quantities of hydrocyanic acid and water taken in definite proportions; not one of these mixtures had a constant melting point (*point de fusion constant*). From his experiments, the author draws the conclusion that two definite hydrates may be said to exist expressed by the formulæ CNH,H_2O and $CNH,2H_2O$; these, by combining together, produce the hydrate $2CNH,3H_2O$.

Iodide of Silicium.—M. Friedel made a brief communication relating to the iodide of silicium, Si_2I_6, which is formed by the action of silver upon the tetraiodide. The first-mentioned substance is decomposed, by heat, into tetraiodide and diniodide; water decomposes this iodide, first forming an unstable hydrate, $Si_2(OH)_6$, which is soon split up, giving rise to the formation of water and silici-oxalic acid, $Si_2H_2O_4$.

Vapour Density of Perchloride of Phosphorus.—M. Wurtz stated that he had repeated experiments on the vapour density of perchloride of phosphorus; his experiments have been conducted at a lower temperature than 160° C., and he has followed the process of Wanklyn, by causing the vapour of the perchloride to diffuse in a known bulk of air. The result of his (Wurtz's) experiments is that 7·2 expresses the vapour density of the perchloride of phosphorus.

The present number of the *Bulletin* contains the following original papers:—

Theory of the Carbides of Hydrogen.—M. Berthelot.—Too lengthy for abstraction.

Formation of Bromide of Acetylen.—M. Berthelot.—The author relates, somewhat circumstantially, how atmospheric influences affect the ready combination of those substances (bromine and acetylen) when in contact; bright sunlight appears to be an essential, but not an exclusive, condition. Since the absorption of acetylen by bromine does not always take place readily, Berthelot advises that when mixtures of gases containing acetylen have to be analysed, subchloride of copper should be used, when no gases but acetylen, absorbable by that substance, are present; subchloride of copper may also be applied as a qualitative test to ascertain whether or not acetylen, when present in a mixture of gases, is being absorbed by bromine, added to the mixture for that purpose. Fuming sulphuric acid was found always to act well, and its action is unaffected by light, a foggy day, or other atmospheric influence.

New Synthesis of Phenol.—M. Berthelot.—This paper is too abstruse for proper abstraction.

Oxidation of the Carbides of Hydrogen.—M. Berthelot.—The author finds that several carbides of hydrogen can be oxidised directly, and without loss of carbon, by the agency of chromic acid dissolved in a small quantity of water. Pure ethylen, free from vapour of ether, is slowly transformed, at a temperature of 120° C., into aldehyd. Propylen is far more readily oxidised, even at the ordinary temperature of the air, aceton being the result of the oxidation; amylen is very violently acted upon by chromic acid, so that no definite products are readily obtained; acetylen is converted into formic and carbonic acids.

Formation of Substances Homologous with Benzin by the Reciprocal Action of more simply composed Carbides taken in Free State, by M. Berthelot; Pyrogenic Formation of the Acetylen of the Benzol Series, by M. Berthelot; Toluidine and Pseudotoluidine, by M. Berthelot; Researches on the Constitution of Toluen and the Alkaloids derived therefrom, by M. Rosenstiehl; New Mode of Preparing Allylic Alcohol, by MM. Tollens and Henninger; Bromide of Allyl and the Essential Oil of Mustard, by M. B. Tollens; Boiling Points of the Allylic Compounds, by M. B. Tollens; Electrolysis of Tartaric Acid and Tartrates, by M. Edm. Bourgoin. These memoirs, evidently concisely written abstracts of longer papers, embodying an enormous mass of scientific research, cannot be properly abstracted, so as to do justice to the authors and their labours.

The remaining pages of this periodical are filled with abstracts taken from papers published in English, German, and French scientific journals, and also scientific books; but the contents of these abstracts are known to our readers, and are frequently taken from works published some years ago.

Journal fur Gasbeleuchtung, April, 1869.

As may be inferred from its title, this periodical is more especially devoted to the interests of gas lighting; occasionally, however, it contains papers of interest to scientific readers, and when this is the case, as in the present instance, we shall make a brief abstract of such paper.

Influence of Heat upon the Regeneration of Sulphide of Iron.—It is well known that, according to theory, only oxide of iron and sulphur should result from the exposure to air of the oxide of iron applied for the purposes of purifying coal gas; in practice, however, it has been found that peroxide of iron, protoxide of iron, and sulphuric acid are also formed, but in variable quantities. Dr. A. Wagner has instituted a series of experiments, in order to ascertain the influence of heat and moisture upon the regeneration process. One sample of sulphide of iron, prepared by the moist way, was kept for three weeks at nearly 100° C., damp, and exposed to air; another portion was kept cold and damp, and exposed, for the same time as the foregoing, to air; while a third portion, under otherwise the same circumstances as No. 2, was kept dry. The result of these experiments is, that heat favours the production of sulphuric acid, while water or moisture does not exert any influence; that moisture and cold (ordinary temperature) produces less sulphuric acid than dryness and cold, since, in the former instance, the occasional watering with cold water, to keep the mass moist, favours a lowering of temperature which, when no moisture is present, is raised, in consequence of the chemical action; water is, however, absolutely required, in order to re-produce the peroxide of iron, since sample 3 was found to have been only very imperfectly converted into peroxide, more than half of the oxide being found as protoxide. The quantities, as deduced from the experiments, are the following:—Sample 1 (hot and moist)—Upon 1 part of S, 0·319 part

of SO_3; and upon 1 part of Fe_2O_3, 0·1 part of FeO. Sample 2 (cold and moist)—Upon 1 part of S, 0·034 part of SO_3; and upon 1 part of Fe_2O_3, 0·151 part of FeO. Sample 3 (cold and dry)—Upon 1 part of S, 0·085 part of SO_3; and upon 1 part of Fe_2O_3, 0·5 part of FeO.

Moniteur Scientifique, No. 298, 1869.

This number does not contain any original articles; a portion of its pages are devoted to the description of the specification of patents, the subject matter of which is already known to our readers. Among the miscellaneous matter we observe the following:—

Improved Preparation of Neutral Acetate of Copper.—Five kilos. of sulphate of copper are ground to a fine powder; this having been done, the powder is placed in a suitable vessel, and 7·5 kilos. of liquid ammonia added thereto. After the solution is effected, 10 kilos. of acetic acid are added, and the vessel containing the copper solution placed on a water-bath; as soon as crystals are observed on the top of the liquid, the latter is strongly stirred, which promotes the formation of crystals. By this process, about 4 kilos. of neutral acetate of copper are obtained from the above quantity of sulphate, while the mother liquor yields some sub-acetate of copper afterwards.

Silicium contained in Aluminium.—It is well known that the aluminium of commerce is always contaminated with silicium and iron; a sample of aluminium recently analysed by Prof. Rammelsberg gave as much as 10·46 per cent of silicium, and another sample even 13·9 per cent. The quantity of iron varies from 2·94 to 7·5 per cent.

Silvering Cast-Iron.—M. Bœttger recommends the use of a bath prepared in the following manner:—15 grms. of nitrate of silver are dissolved in 250 grms. of water, and 30 grms of cyanide of potassium are added; when the solution is complete, the liquid is poured into 750 grms. of water wherein 15 grms. of common salt have been previously dissolved. The cast-iron intended to be silvered by this solution should, after having been well cleaned, be placed for a few minutes in a bath of nitric acid of 1·2 sp. gr., just previous to being placed in the silvering fluid.

Les Mondes, May 20, 1869.

We only notice the following from this paper:—MM. Wurtz, Bouchardat, Gübler, and Bergeron have been appointed to study the not altogether easy, but important question, Whether the addition of alcohol to wine, after its fermentation has entirely ceased, is injurious to the health of the consumer.

The title of the following work, from the eminent *savant's* well-known reputation, will not, we think, be unacceptable to many of our readers:—"L'Unité des Forces Physiques, Essai de Philosophie Naturelle," par le R. P. Secchi, Membre Correspondant de l'Institut de France, Directeur de l'Observatoire de Rome, Officier de la Légion d'Honneur, &c. Edition originale Française, grand 8vo., xx. and 700 pages; 56 woodcuts. Paris, 1869.

May 27, 1869.

This number does not contain any original communications or papers.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 7, April 24, 1869.

This periodical contains the following original papers:—

On the Toluylen Group.—MM. Limpricht and Schwanert.—The authors begin this paper with an introduction, wherein they state that the reader of their present paper is referred back to memoirs of theirs published some years ago; next, they give a review of chief combinations of the toluylen group, being a series of some thirty chemical formulæ and names (too many to quote here); and they wind up with theoretical considerations on the relations existing between benzin, benzoin, toluol, benzil, and toluylen.

History of the Aldehyde of Salicyl.—M. L. Henry.—Since salicylic alcohol—

$$C_6H_4\begin{matrix}HO\\CHO,\end{matrix}$$

is an aldehyde, as well as a phenol, the author argues that it must be possible to obtain, from the salicylic alcohol, doubly chloruretted cresol, triply chloruretted toluol, and chloruretted aldehyde of salicyl. The author has succeeded in obtaining these compounds from the salicylic alcohol, and in this paper he describes, at length, the processes applied. Doubly-chloruretted cresol—

$$C_6H_4\begin{matrix}HO\\CHCl_2,\end{matrix}$$

is a solid substance, crystallising in prisms, fusing at 82° C.; its alcoholic solution yields, with chloride of iron, a dark red colour. Triply-chloruretted toluol—

$$C_6H_4\begin{matrix}Cl\\CHCl_2,\end{matrix}$$

is an oily liquid insoluble in water; specific gravity, 1·4; boils at 227° C. Chloruretted aldehyde of salicyl—

$$C_6H_4\begin{matrix}Cl\\CHO,\end{matrix}$$

is a colourless liquid, boiling at 210°.

Tension of Vapour, and Heat of Volatilisation of Chloride of Ammonium, by Aug. Horstman, and **Observations on the Aromatic Theory**, by A. Ladenburg, are both too abstruse for translation, an observation which equally applies to M. Buff's paper, **On the Doctrine of Affinity**, a most erudite essay on a difficult subject. Next follow two papers, by two different authors, on the same subject:—C. Rammelsberg's essay, **On the Formation of Periodates from Iodides, by means of Superoxides**; and J. Phillipp's paper, **On the Formation of Periodates**. Contributions to our Knowledge of Methyl-Aldehyde, by A. W. Hoffmann. All these papers being concisely-written and purposely-condensed abstracts made for this periodical, cannot be further condensed.

Polymeric Cyanobromide.—A. Eghis.—When freshly-prepared cyano-bromide is placed in a sealed tube, and exposed therein for from eight to ten hours, to a temperature of from 130° to 140° C., the at first crystalline cyanobromide is converted into an amorphous, yellowish-coloured mass, this colouration being due to free bromine, while, at the same time, at the moment of the unsealing of the tube, cyanogen gas escapes. The author found that, with the product prepared in the manner just briefly described, he could not obtain the results he desired to have; he therefore placed freshly-prepared cyanobromide into anhydrous ether, and digested these substances for some time; he thus obtained a perfectly white amorphous powder, insoluble in benzol and absolute alcohol, and fusing at 300°. By analysis, this substance was proved to be a cyanobromide of the formula Cy_2Br_2, containing 74·89 per cent of bromine.

Zeitschrift für Chemie, von Beilstein, No. 8, 1869.

There are no original articles contained in this number, which is entirely filled with translations, chiefly from French papers of older date, the contents of which have already been recorded in the Chemical News.

Comptes Rendus des Séances de l'Académie des Sciences, Monday, May 24, 1869 (No. 21).

Improvement of the Health of Workpeople, by an Improved System of Ventilation and Better Supply of Fresh Air to the Manufactories, illustrated by the good effects obtained at the Weaving Factory of Orival, near Lisieux.—General Morin.—Although, in the strictest sense, the subject matter of this paper does not belong to our department, we briefly notice that, in a factory wherein 400 people are daily employed, it becomes a matter of great importance to see to their health, especially in respect of fresh air. The General having been consulted on this subject by the owner of the factory, the former advised that at least 300 cubic metres per head, per hour, should be allowed for fresh air, provision being made to supply it so as to have a proper degree of moisture, as well as a proper degree of heat; into the minute details of the mode of supply, and carrying off the foul air, we do not enter, as this is a matter very much dependent on local conditions of buildings. The good results are proved by the fact (in this instance) that the yearly outlay for medicines had been reduced from 5,000, to less than so many hundreds of francs; while the consumption of bread had largely increased, as compared with the period previous to the making of the above-named improvements.

Distribution of Heat, and Work of the Induction Apparatus.—M. Le Roux.—This is a physico-mathematical essay, too abstruse for condensation.

Means of Ascertaining the Age of any Writing made with Ink containing an Iron Salt.—M. Carré.—The author states that, as long as writing is not very old, it admits of being copied, when moistened with water only, by means of the well-known copying press; further, that when writing has once attained a certain age, an alteration has taken place in the ink, which prevents the ordinary process of copying being successful; but, in that case, moistening with water acidulated with hydrochloric acid effectually aids the copying process. When, however, writing is some eighty years old, this contrivance also fails to aid the copying process; M. Carré found that writing, made in 1787, could not be reproduced by copying press, even when previously moistened with acidulated water.

Experiments on the Quantity of Mud and Slime carried down by Rivers.—M. Hervé-Mangon.—The author finds that the river Var carries from 9·15 to 36·61 grms. to the litre of water, of mud, amounting in one year, on an average, to 18,000,000 kilos., a quantity sufficient to raise a surface of 5,500 hectares (1 hectare = 2·471 acres), 20 centimetres in height. The rivers Marne and Seine carry down far smaller quantities of solid materials.

Second Note on Saturation, Surfusion, and Solution.—M. Dubrunfaut.—This is an abstract too concisely written and too long to admit of further condensation.

New Source of the First Terms of Acids belonging to the Fatty Acid Series, and especially on Propionic Acid.—M. Barré.—We hope to return to this paper, and give it in full, at a future time.

Climate of the Isthmus of Suez.—Referring to this subject, M. Le Verrier read an abstract of a letter from Prof. Buijs-Ballot, the Director of the Royal Netherlands Meteorological Institute at Utrecht, wherein that gentleman states that the draining of the Haarlem lake, in Holland, a surface of 19,000 hectares, has had the effect of increasing the average summer temperature of that locality, and adjacent country, by ½°, and of decreasing the average winter temperature, also, by ½° C.

Cosmos, 22nd livraison, May 29, 1869.

The present number of this periodical does not contain anything fit for abstraction for these columns, though, as usual, the periodical is very cosmopolitan and entertaining to general scientific readers.

Annalen der Chemie und Pharmacie, vi., Supplementband, Heft 3, 1868.

As usual, this supplement appears rather late in the present year. It contains the following original essays:—

Combinations of Phosphorus.—M. H. Wichelhaus.—The tendency of this essay, for it is that rather than a paper, may be inferred from the title and introduction, wherein the author says, "It is my aim to prove that it is unnecessary to assume anything else for phosphorus than triatomicity." The author, before entering upon his subject, discusses the word and meaning of quantivalence, and next writes an essay, filling some thirty closely-printed octavo pages, too concisely constructed for further abstraction.

Isomerism of Bicarbonate of Ethylen and Ethyliden, by M. H. Wichelhaus.—**Development of Heat of Chemical Reactions, as dependent on the Change of the Number of the Molecules of Substances**, by Dr. A. Naumann.—**Vapour Tension of Formiate of Ethyl and Acetate of Methyl**, by M. C. W. Dittmar.—**Relation Existing between the Chemical Composition of Arable Soil, and its Property of Yielding a Good Harvest**, by M. Schultze.—**Ammonium-Amalgam**, by M. Laudolt.—**Isomeric Derivatives of Allyl and Propylen**, by M. Alphonso Oppenheim.—**New Method of Formation of Resorcin**, by MM. Oppenheim and Vogt.

Journal fur Praktische Chemie, No. 4, 1869.

This periodical contains the following original papers:—

On Patellaric Acid, a New Lichen Acid, and its Existence in the Parmelia scruposa.—M. H. Weigelt.—The author has written a lengthy essay on this subject. Patellaric acid is a solid, exhibiting crystalline form and snow-white colour; its taste is exceedingly bitter; it is soluble in water, alcohol, and ether; and these solutions redden blue litmus paper. The percentage composition of this acid is:—C, 53·1; H, 5·2; O, 41·66. Space forbids us to quote any more from this paper, which contains the records of a long series of researches, not only on this acid, but on lichens generally, and the *Parmelia scruposa* especially.

Methintrisulphonic Acid.—M. Theilkuhl.—This acid is obtained when methyloxysulphate of lime is treated with a large excess of fuming sulphuric acid. The lime-salt of this new acid has the following percentage composition:—C, 3·62; H, 0·91; S, 29·00; Ca, 26·13; O, 43·34. The formula is:—

$$(C_2H)\left[\begin{matrix}S_2O_4\\S_2O_4\\S_2O_4\end{matrix}\right]O_9Ca_3+2H.$$

The author has also studied the baryta, potassa, and lead salts of this acid.

Amylendisulphinic Acid.—Dr. Ilse obtained this substance when he made sulphate of chloride of carbon, $C_2Cl_3(S_2O_4)Cl$, and zinc-ethyl act upon each other. The above-named acid has the following formula:—

$$C_2\left\{\begin{matrix}\dot{C}_4H_5\\C_4H_5\end{matrix}\right.\left[\begin{matrix}S_2O_3\\S_2O_3\end{matrix}\right]\begin{matrix}O.H\\O.H.\end{matrix}$$

The baryta salt of this acid is a crystalline solid mass, not readily decomposed spontaneously, of the following composition:—

$$C_{10}H_{10}\left[\begin{matrix}S_2O_3\\S_2O_3\end{matrix}\right]O_3.Ba_3+4H.$$

It is soluble in water, difficultly soluble in alcohol.

Researches on the Influence which the Presence or Absence of Water Exerts in regard to the Vitality of the Yeast, or Ferment Cells.—Dr. J. Wiesner.

Ethylenchloride of Iron and Peruvian Balsam.—M. J. Kachler.—Ethylenchloride of iron, $C_2H_4.Fe_2Cl_3$, is formed when a solution of chloride of iron in ether is submitted to a high temperature in sealed glass tubes; it is a solid crystalline substance. As regards Peruvian balsam, the author states that it yields an excellent source of supply of pure benzilic alcohol. From 100 parts, by weight, of the balsam, he obtained 20 parts of benzilic alcohol, 46 parts of crude cinnamic acid, and 32 parts of resin, which, on being oxidised with potassa, yields benzoic and protocatechucic acids.

System of Elements, according to their Atomic Weights and Chemical Functions.—M. D. Mendeleeff.

NOTES ON LECTURE EXPERIMENTS.

Combustion of Sodium.—The metal sodium is stated not to take fire on cold water, but this is incorrect. A small piece of the metal will not do so, but a piece the size of a nut will frequently ignite; the flame may suddenly "pop" out, and it may as suddenly become ignited again. It is also addicted to the unpleasant habit of suddenly bursting into fragments, and throwing the fragments of metal in all directions. After the combustion of any considerable quantity of the sodium, it is curious to observe how the soda may be seen tinging with a yellow colour the non-luminous portion of any gas jet that may be burning. —G. N. M., Northampton, May 26, 1869.

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1277. J. Scharr, Stuttgard, Wurtemburg, "Improvements in the manufacture of liquid soap."—Petition recorded April 24, 1869.

1391. C. D. Abel, Southampton Buildings, Chancery Lane, "Improvements in the treatment of cast-iron for the production of wrought-iron and steel therefrom."—A communication from W. M. Lyon, Pittsburg, Penn., U.S.A.—May 6, 1869.

1409. F. C. Knowles, Lovell Hill, Berks, "A new or improved method of purifying and converting cast-iron into malleable iron or into steel, and for the making and use of materials and appliances for the same."

1413. E. Maybury, G. Matthews, and E. Marston, Pendleton, Lancashire, "Improvements in puddling furnaces."—May 8, 1869.

1414. R. Cadbury and G. Cadbury, Birmingham, and J. M. Rendall, Torquay, Devonshire, "A new or improved description of biscuit manufactured from the cacao bean."—Petition recorded May 8, 1869.

1418. H. R. Lumley, St. John's Wood, "The treatment of molten iron in order to free it from all impurities."

1419. H. A. Dufrené, Rue de la Fidélité, Paris, "Improvements in desiccating and preserving meat and other organic substances."—A communication from C. Tellier, Passy, Paris.

1426. W. E. Newton, Chancery Lane, "An improved process and composition for hardening common or grey cast-iron, and for converting articles of iron into steel, or imparting thereto a steely character."—A communication from B. W. Nichols, Canton, Ohio, U.S.A.

1431. H. Bessemer, Cannon Street, London, "Improvements in the manufacture of malleable iron and steel, and in furnaces and apparatus employed for their fusion and treatment."

1432. H. Bessemer, Cannon Street, London, "Improvements in the construction and mode of working furnaces and apparatus employed in fusing malleable or wrought-iron, and steel and pig, or other carburets of iron, and obtaining cast-steel, or homogeneous malleable iron therefrom."

1433. H. Bessemer, Cannon Street, London, "Improvements in the conversion of fluid crude iron and molten pig, or other carburets of iron, into fluid homogeneous malleable iron and steel, whether such pig, or other crude iron, is used alone, or is mixed with a portion of malleable, or more or less decarburised iron, in a solid or fluid state."

1434. H. Bessemer, Cannon Street, London, "Improvements in the treatment of crude, or pig-iron, and other carburets of iron, and in the apparatus employed for such purposes."—May 10, 1869.

1435. H. Bessemer, Cannon Street, London, "Improvements in the construction and mode of working blast furnaces employed for smelting the ores of iron, and in the mode of employing and utilising the gaseous products of such furnaces, and also in the construction and mode o working blast engines employed to force air into blast and other furnaces."—May 10, 1869.

1440. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved detergent, or saponaceous compound."—A communication from W. H. Newton, New York, U.S.A.—May 11, 1869.

1450. J. Robey, Newcastle-under-Lyme, "Improvements in sugar refining."

1458. P. W. Flower, Neath, Glamorganshire, H. Nash, Water Street, Liverpool, and R. Heathfield, Birmingham, "Improvements in coating sheets of metals with other metals."—May 12, 1869.

1464. E. V. Newton, Oxford Street, Middlesex, and P. M. Crane, Manchester, "A new or improved composition for coating ships, boats, and other surfaces, and for protecting and preventing the fouling thereof."

1469. J. Townsend and P. Forbes, Glasgow, N.B., "Improvements in refining or treating oils and fats, and in apparatus therefor."—May 13, 1869.

1483. G. Felix, H. J. Axel, F. Bang, F. Roch, C. Monestier, and J. P. A. Fignier, Paris, "An improvement in liquids for the lubrication of sheep's, or other wool, or other animal textile fibrous materials."

1486. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of beet-root and other pulps, and in the machinery or apparatus employed therein."—A communication from H. Champonnois, Paris.—May 14, 1869.

1493. L. A. V. Dubourg, M.D., Leicester Street, Leicester Square, Middlesex, "Improvements in the manufacture of gas for lighting and heating purposes, and in the apparatus employed therein."

1495. W. Wilkinson, Seymour Street, Euston Square, Middlesex, and M. Boss, Cleveland Street, Fitzroy Square, Middlesex, "Improvements in embossing, printing, enamelling, and ornamenting glass, metal, wood, canvas, or other woven prepared fabrics or other substances, and the preparation of the material, or materials and ingredients employed therein, and machinery or apparatus appertaining to a part thereof."—May 15, 1869.

1540. G. Martin, Dursley, Gloucestershire, "Improvements in the means of generating gases and chemical vapours employed in the manufacture of extract wool, and in destroying the vegetable material in mixed fabrics, and in the construction and arrangement of apparatus therefor, which apparatus is also applicable to other purposes."—May 19, 1869.

1562. J. McMillan, Dumbarton, N.B., and J. McGregor, Glasgow, N.B., "Improvements in the preservation of iron and steel, and structures composed thereof."

1568. G. Johnson, San Francisco, California, U.S.A., "Improvements in the distillation of spirituous liquors, and in apparatus to be employed therefor."—May 20, 1869.

NOTICES TO PROCEED.

3959. G. T. Bousfield, Brixton, Surrey, "Improvements in extracting the colouring matter of madder root from the ligneous matter of the plant."—A communication from A. Paraf, New York, U.S.A.—Petition recorded December 29, 1868.

18. H. A. Bonneville, Chaussée d'Antin, Paris, "Certain improvements in the process of refining iron and making steel, and in the apparatus used in carrying out said process."—A communication from C. J. Cainnon, Toulouse, France.—January 4, 1869.

42. K. Walter, Wicklow, "Improvements in the manufacture of sulphuric acid."—January 6, 1869.

62. W. T. Waite, Salisbury Square, London, "Improvements in the treatment of saccharine matters."—January 8, 1869.

98. C. J. Günther, Mark Lane, London, "Improvements in salting and preserving meat."—A communication from Baron J. von Liebig, Munich, Bavaria.—January 13, 1869.

230. A. V. Newton, Chancery Lane, "An improvement in fermenting substances and germinating grain and seeds."—A communication from R. d'Heureuse, San Francisco, California, U.S.A.—January 25, 1869.

1278. T. Forster, Streatham, and P. B. Cow, jun., Streatham Common, "Improvements in compounds containing india-rubber, gutta-percha, or ballata, and in the manufacture of such compounds." April 24, 1869.

NOTES AND QUERIES.

Benzoic and Succinic Acids.—The commercial use of both these acids is very limited. Benzoin *resin* is used in perfumery, varnish making, and dyeing; in this latter operation both benzoic and succinic acids are also used and applied to a limited extent as mordants; beside this, both these acids are used in pharmacy, and, as is well known, applied in analytical chemistry, as ammonia salts chiefly; their high price would prevent their very extended use.

Mineralised Manure.—It appears from a short notice in *Les Mondes*, chiefly intended *pour prendre date*, that there has been found, in the Department of the Haute-Saône, near Lure, a layer of from 40 to 100 metres thickness of a mineral made up of from 3 to 4 per cent of bituminous oil, 2·8 of nitrate of ammonia, 5·8 of nitrate of potassa, 40 of carbonate of lime, 25 of gelatinous silica, 0·5 of oxide of iron, and 0·1 of sulphur. This mineral deposit appears to be the result of the slow decomposition of vegetable and animal matter, especially molluscs, belonging to a former period of animal life on our globe.

Water Saturated with Gypsum.—The result of the analysis, by Dr. F. Goppelsroeder, of a spring water found on the Dürenberg Estate, near Langenbruck in Silesia, gave for the saline matter found in 1000 c.c. of water:—1·636 grms. of anhydrous sulphate of lime, 0·185 of sulphate of magnesia, 0·019 of carbonate of lime, 0·024 of carbonate of magnesia, 0·008 of carbonate of protoxide of iron, 0·005 of silica, 0·06 of chlorine (combined with alkalies); moreover, small quantities of alumina, baryta, strontia, ammonia, phosphoric acid, nitric acid, and organic matter, which were not quantitatively determined. The solid residue of 1 litre of water, dried at 100° C., amounted to 2·503 grms.

Natural Water Containing Excess of Oxygen.—At Neubourg, Departement de l'Eure, France, a spring of mineral water is found, from which a gas is constantly bubbling up and given off in large quantity, which, on analysis, proved to contain 44·6 per cent of oxygen, and 55·4 per cent of nitrogen; the gas causes, just as pure oxygen does, partly extinguished but yet glowing splints of wood to burst into flame. The analysis of the water proved it to contain in 4 litres the following quantities of saline constituents, expressed in gramme weight:—

	grm.
Chloride of potassium	0·0096
Phosphate of lime	0·0128
Alumina and peroxide of iron	0·0200
Silica	0·0140
Sulphate of lime	0·0348
Chloride of magnesium	0·0688
Nitrate of magnesia	0·0878
Carbonate of lime	0·7210
	0·9688
Free carbonic acid	0·3284

—*Annuaire Pharmaceutique for* 1868.

Aniline Black.—The best kind of this dye is called in France, *Noir d'Anilin Lucas*; in England it is known as Petersen's aniline black; it is made, by a process kept secret, by M. F. Petersen, at St. Denis, near Paris. It is met with in commerce as a very deep black-coloured fluid, which, for the purposes of calico-printing and dyeing, has only to be thickened with starch paste, imparted to the tissue, and oxidised, to produce the finest deep black velvety-looking dye ever obtained. Among the very large number of prescriptions for manufacturing aniline black we notice Coupier's method, which is the following:—A mixture is made of 175 parts of nitrobenzin, 175 of aniline, 200 of commercial hydrochloric acid, 16 of iron turnings, and 8 of finely divided copper; this mixture is heated for from 6 to 8 hours at from 160° to 200° C., in an inside-enamelled iron-ware distilling apparatus. The operation is finished when a small portion of the mixture, having been previously removed from the apparatus and cooled, can be drawn into a tough thread-like mass, when rapidly pulled between the fore-finger and thumb. The dye produced in this manner is soluble in acids, alcohol, and wood-spirit. When it is intended to apply this substance as a dye, it is dissolved in sulphuric acid, serving as a dye bath, after which the woven tissue, thread, or yarn, has to be bathed in a solution of either an alkali or hyposulphite of soda, in order to fully develope the black dye; without this precaution a black, verging upon violet or blue, is obtained.

Contraction of Caoutchouc by Heat.—It appears that M. Govi, at Turin, has repeated the well-known experiments of Joule and Thomson about the contraction which caoutchouc, after having been previously stretched out, undergoes when heat is applied. The author has found that this contraction only takes place within certain limits of temperature, and that, if a greater degree of heat be applied, the stretched-out caoutchouc, even though by no means exposed to a degree of heat which softens it to a pasty mass, expands and becomes rapidly longer. This substance, which has, in some aspects, puzzled philosophers, especially as regards some of its physical properties, has been frequently considered to consist of a kind of solid foam, made up of a large number of small vesicles filled with gas. This theory has been proved to be a reality, since Payen and others have seen these vesicles under the microscope, while M. Grovi has succeeded in expelling a portion of the gas from the vesicles by softening the caoutchouc, by means of oil of turpentine, and withdrawing, by means of the vacuum of the air-pump, the ordinary atmospheric pressure. This peculiar kind of constitution of the caoutchouc being admitted, it is easily seen that the vesicles, when that material is stretched, will lengthen in the direction of the stretching force, and contract—become more narrow—in the perpendicular direction to that force. When, under these conditions, the caoutchouc is heated, the gas within the vesicles, while expanding, will have a tendency to return to the spherical shape it possessed before being stretched, and this explains, therefore, the paradox of its becoming shorter while heated; in other words, contracting instead of expanding by heat.—*Les Mondes*.

MEETINGS FOR THE WEEK.

MONDAY, 7th.—Royal Institution, 2. General Monthly Meeting.
TUESDAY, 8th.—Photographic, 8.
WEDNESDAY, 9th.—Microscopical, 8.
—— Geological, 8.
THURSDAY, 10th.—Royal, 8.30.
—— Zoological, 8.
—— Royal Society Club, 6.
FRIDAY, 11th.—Astronomical, 8.
SATURDAY, 12th.—Royal Institution, 3. Mr. Deutsch, "On Semitic Culture."

TO CORRESPONDENTS.

*** We shall feel indebted to correspondents who will forward us Reports of Local Meetings of Societies, Chemical Appointments, and any other subjects interesting to the chemical world. We regret that, owing to the increasing popularity and circulation of the CHEMICAL NEWS, and consequent pressure on our space, we are often obliged to delay the publication of long papers. To those correspondents who wish to favour our readers with Notes of New Discoveries, Descriptions of Apparatus, or Answers to Questions, we would especially recommend our Notes and Queries columns.

E. K.—The lecture will be shortly published in our pages. Our publisher will write to you about the volumes of the CHEMICAL NEWS. The acid liquid is probably deliquesced phosphoric acid. We cannot vouch for the statements made by advertisers unless we have personally inspected the goods.

Tyro.—Add ammonium sulphide to the solution; collect, wash, and dry the precipitate, and fuse with a mixture of nitre and carbonate of soda.

H. Kelsoe.—The Adulteration of Food Bill, passed some years ago, is practically inoperative.

X. Q.—Cadmium amalgam is not at all brittle, but is tough, and highly malleable.

Messrs. J. B. and Co.—A letter is waiting for you at our office.

G. N. M.—There is no good description of the battery published. The manufacturer will give you any information you require.

Communications have been received from A. Voelcker; B. Kernas; C. Higgins, B.A.; P. M. Muir; S. Dunn; J. Davis (with enclosure); J. Pride; R. R. Tatlock; W. A. Todd; E. C. C. Stanford; F. A. Abel, F.R.S. (with enclosure); F. Jennings; R. D. Grindley; Mawson and Swan; A. Baxter; J. Heywood; Longmans and Co.; Dr. Röhrig; J. Spiller; Dr. E. Fleischer (Dresden); J. Hughes; E. H. von Baumhauer; G. Pearson; H. Yeates; C. Tomlinson, F.R.S.; B. Quaritch; Dr. Adriani; The Royal Institution; E. P. H. Vaughan; A. Clarke; and S. W. Rich.

BOOKS RECEIVED.

Spectrum Analysis; Six Lectures delivered in 1868 before the Society of Apothecaries of London. By Henry E. Roscoe, B.A., Ph.D., F.R.S. With appendices, coloured plates, and illustrations. London: Macmillan and Co.

Archives Néerlandaises des Sciences Exactes et Naturelles, Publiées par La Société Hollandaise des Sciences à Harlem, et Rédigées par E. H. von Baumhauer. La Haye: Martinus Nijhoff. Londres: Trübner and Co.; Williams and Norgate.

THE CHEMICAL NEWS.

VOL. XIX. No. 497.

CHEMICAL EXAMINATION OF THE ORIENTAL JARGON.*

By DAVID FORBES, F.R.S., &c.

A SHORT time back, I undertook, at the request of Mr. Sorby, to prepare for him some of the earth or earths which, in combination with silicic acid, formed this gem, and as the means I employed in so doing appeared to throw some little light upon the characters of the earth hiterto regarded as zirconia, I have thought that a notice of the results obtained by me might not be devoid of interest.

The jargon employed was in fragments, being part of an almost colourless crystal, forwarded to me by Mr. Sorby, who had previously found, by optical examination, that it showed with great distinctness the peculiar and characteristic spectrum which he ascribes to the presence of the new element jargonium, and noticed that the bands became much more pronounced after ignition and cooling.

The fragments, which were extremely hard, were broken up in a diamond mortar, previous to being reduced to as impalpably fine a powder as possible in an agate mortar; 16·22 grains of this powder were then thoroughly mixed with 81 grains pure anhydrous carbonate of soda, placed in a platinum crucible, and fused at the highest heat of a large air gas blowpipe jet, after having been previously kept for two hours over a powerful Bunsen's flame, so as to "frit it," or ensure combination previous to fusion. After complete fusion, a small lump of pure hydrate of soda (about 15 grains) was, as recommended by Berzelius, carefully deposited in the centre of the fused mass, and a second similar piece added after the first had been absorbed; the fused substance became much more liquid after this addition; the heat was kept up for another half hour longer, and the whole was allowed to cool.

By the above means the mineral was perfectly decomposed, and the silica so altogether transferred to the soda that it could be completely removed by cold water, leaving no trace behind with the earths. Previous experience with the zircons from various localities, and hyacinths from Ceylon, had proved to me that the perfect decomposition of these minerals is often attended with considerable difficulty.

The fused mass when cold was treated repeatedly with cold water in a silver vessel, decanting off the supernatant solution each time, until the silica was entirely removed, and a white powder, probably a compound of the earth with soda, remained behind.

The solution which contained all the silica was acidified with hydrochloric acid, evaporated to dryness, and the silica determined as usual. The silica obtained weighed 5·45 grains, consequently was equivalent to 33·61 per cent in the mineral.

The white insoluble residue previously mentioned, was found to be perfectly soluble in hydrochloric acid; in order to test if it contained any silica, the solution was evaporated to dryness and re-dissolved in water acidulated by HCl, but left no trace of insoluble matter behind. From the colour of the solution being distinctly yellow, it evidently contained oxide of iron, which I had scarcely expected, since the original mineral was nearly, if not altogether, devoid of colour; the solution, consequently, was a chloride of the earths of the jargon, accompanied by some sesquichloride of iron.

Berzelius many years ago devised a means of separating oxide of iron from zirconia, founded upon the behaviour of their respective chlorides, the sesquichloride of iron being soluble in strong hydrochloric acid, whilst that of zirconia is nearly insoluble; I had tried this process previously with zirconia from Ceylon hyacinths, and had not been satisfied with it, as the iron solution carried along with it a not inconsiderable portion of the earth. It now struck me, however, that possibly the earth so dissolved might differ in character from that contained in the insoluble chloride, and I therefore determined to make the experiment.

The hydrochloric acid solution was consequently again evaporated until it solidified as a yellow saline mass, whereupon it was treated repeatedly with cold strong hydrochloric acid of density 1·138, allowing it to stand some time and decanting the solution as long as the fresh acid acquired the faintest yellow tinge. A yellow solution was obtained, leaving behind a snow white chloride, crystalline in appearance and completely soluble in water, forming a perfectly colourless solution. From this solution ammonia precipitated a flocky, but apparently rather dense, white precipitate, which, after being thoroughly washed, dried, and ignited, was of a pure white colour and possessed a peculiar waxy look and dense appearance; it weighed 7·48 grains, and consequently amounted to 46·12 per cent of the jargon examined.

This earth was examined optically by Mr. Sorby, and, according to his account, did not give a trace of the characteristic jargonium bands in the spectrum, and it was, therefore, concluded to be pure zirconia.

The yellow hydrochloric acid solution was now examined, and found, besides sesquioxide of iron, to contain a considerable amount of an earthy base, like zirconia. I decided to separate the iron by the tartaric acid and sulphide of ammonia process recommended by Berzelius, and, consequently, the solution was first supersaturated by ammonia, which threw down a faint yellowish white somewhat flocculent precipitate. Tartaric acid in excess was then added, which dissolved at once the greater part of the precipitate, but, notwithstanding that a very large excess was added, a portion of the precipitate refused obstinately to re-dissolve, even upon application of heat. In order to examine this, the solution was filtered: a white, flocculent, and somewhat glutinous substance was left upon the filter, which, when well washed with hot water, dried, and ignited, weighed 1·24 grains, equivalent to 7·64 per cent of the original mineral.

This body, after ignition, appeared very different from the previously-obtained zirconia; it was a white powder, but did not aggregate together or form lumps having a waxy lustre on the surfaces of fracture; on the contrary, it was more pulverulent, had a dead white, or mealy, appearance, and did not appear to be of any great density.

From Mr. Sorby I learn that it gave the spectrum of jargonium with intensity, and he concludes that it must probably be its pure oxide or jargonia.

Ammonia was now added in excess to the tartaric acid solution, which remained clear. Upon the further addition of sulphide of ammonium, the solution assumed a dark brown coloration; but no precipitate separated before the lapse of some days, when a black deposit of sulphide of iron formed, which was collected upon a filter, after the greater part of the supernatant liquid had been carefully syphoned off.

This sulphide of iron was converted into sequioxide, and afforded 0·04 grain, equivalent to 0·24 per cent in the mineral.

After separation of the iron, the solution was evaporated to dryness in a platinum capsule, and ignited for some time, to drive off all ammoniacal salts, and oxidise the carbon resulting from the decomposition of the tartaric acid. There then remained behind an earthy body, of a

* Although is commerce this mineral is generally known as the jargon from Ceylon, the name Oriental jargon seems to me to be preferable, since it appears uncertain whether these stones are actually found in the Island of Ceylon, that place being well-known as the principal Eastern mart for precious stones procured on the mainland of India and the adjacent countries.

white colour, having a slight tinge of grey, which weighed 2·03 grains, or 12·52 per cent.

In appearance, this earth was quite different from the zirconia, and more resembled that supposed to be jargonia. Mr. Sorby, upon optical examination, reports that "It seems to contain a good deal of zirconia and a very decided trace of jargonia, but I am very much inclined to suspect that it may contain some other substance. Its behaviour with borax before the blowpipe is very different from that of the zirconia from the jargon, and it turns extremely opaque, and a sort of orange-yellow, by transmitted light." Possibly this substance may contain a third earth analogous to zirconia, such as Svanberg (*Ofversigt. Kongl. Vet. Acad.*, pp. 34, 37, 1845) suggested was present in eudialite and certain zircons.

The result of this examination of the jargon, when summed up, indicates its composition to be as follows:—

	In 16·22 grains.		In percentage.	
Silica	5·45		33·61	
Zirconia α	7·48		46·12	
,, β (jargonia?) ..	1·24	10·75	7·64	66·28
,, γ	2·03		12·52	
Sesquioxide of iron ..	0·04		0·24	
	16·24		100·13	

The formula ZrO_2SiO_2 ascribed to zircon requires—

Silicic acid	33·77
Zirconia	66·23
	100·00

with which the numbers found for jargon are closely approximative.

The results of this chemical examination must be considered as strengthening the evidence, physical and chemical, that the earth usually denominated zirconia is, in reality, a compound of two, if not more, closely-allied oxides. In 1845, Svanberg announced that the zirconia contained in the various zircons from Siberia, Norway, and Ceylon, as, also, in the hyacinths from Expailly and Ceylon, was a compound of two or more earths, one of which he termed noria; and, in a subsequent paper the same year, also found this to be the case with the earth in the Greenland eudialite. His arguments—for he did not succeed in separating the earths—were founded upon his observations that the salts of zirconia did not always contain the same constant proportion of acid to base; that the oxalates, chlorides, and sulphates differed in their behaviour and solubility in certain reagents, and that the specific gravities of the natural silicates (zircon) from various localities differed greatly from one another.

These observations of Svanberg, notwithstanding the promise contained in his short paper on the subject to bring forward fuller evidence, have, as yet, never been followed up by him, and the subsequent researches of other chemists appear to throw doubt as to their correctness in several points, as well as to render the existence of his noria extremely dubious. The researches of Berlin (*Journ. f. Prak. Chemie*, lviii., p. 145, 1853) showed that the results of the fractional precipitation of chloride of zirconia by oxalic acid did not warrant the conclusions of Svanberg, and that the zirconia prepared from zircons from Frederiksvaern, Expailly, Ural, India, and from the Ceylon hyacinths and Norwegian katapleeite, behaved in similar manner with oxalic acid, and that their oxalates were easily and completely soluble in excess of that acid, and that the specific gravity and amount of zirconia obtained from the oxalates from Frederiksvaern zircon and katapleeite which he examined were identical, so that it would seem necessary to seek for some other means of separating the earths than by the employment of oxalic acid. In some experiments I made for the purpose of attempting to isolate noria (in which I used Norwegian zircons from two different localities, and also hyacinth from Ceylon), I failed in so doing, but corroborated the results obtained by Berlin.

In 1864, Nylander, in a paper, "Bidrag til Kännedomen om Zirkonjord" (*Acta Universitatis Lundensis*, 1864), has examined the zirconia from the Norwegian eucolite, and considers that it contains two earths, which differ in their behaviour and solubility of their double potassium sulphate salts, but he also appears to have come to no definite results as to the existence or isolation of the earths themselves.

It is to be hoped, however, that the interest now excited by Mr. Sorby's announcement of the existence of jargonium will induce chemists to work the subject out in more detail.

ON THE

EXAMINATION OF WATER FOR ORGANIC MATTER.*

By R. ANGUS SMITH, Ph.D., F.R.S., &c.

In 1865 I received a request to write on the organic matter of water. I wrote a memoir, which was, without intending to be published, extensively circulated among officers of of health, especially in India.

I there made a division which was entirely new to chemists. The substance styled "organic matter," instead of being given as one to which little or no definite meaning was attached, was considered as existing chemically under at least seven different headings, not forgetting the numerous organised forms which it might assume. These divisions were—

1st. The organic matter decomposed, or putrid.
2nd. Organic matter readily decomposed, and probably ready to become putrid.
3rd. Organic matter slow to decompose.
4th. Recent organic matter.
5th. Old organic matter.
6th. Vegetable organic matter.
7th. Animal organic matter.

The first was known by the gases which instantly decomposed permanganate.

The use of the permanganate of potash, recommended by Forchhammer for ascertaining the organic matter of water, has been tried and admired by some, and found entirely wanting by others.

I endeavoured to show, in the memoir alluded to and in a subsequent paper, how far that salt could be trusted; quite certain of its value for ascertaining bodies of the first and second classes, but having no experience of my own which would guide me to consider it a sufficient test for the total quantity of organic matter.

Bodies of the third class I was therefore inclined to estimate quantitatively by drying and weighing, afterwards ascertaining the condition of the matter as the point of most importance.

Organic matter of the fourth class was estimated by the amount of nitrites in the water, because their existence showed that the matter was oxidising, but had not had time to complete the action.

Bodies of the fifth class were estimated from the nitrates, as in that case the action was finished.

Bodies of the sixth class were reckoned from the absence of bodies of the seventh class, which latter class, again, were considered to exist when they were accompanied by an unusual amount of chlorides, supposing care to be taken to discover that other sources of chlorides did not exist.

It is not to be expected that any of these divisions should be sharply defined; but the one most difficult to decide upon, to all appearance, is really that which I have found, with proper precautions, scarcely ever to fail me, though

* From vol. iv., 3rd series, of the *Memoirs of the Literary and Philosophical Society of Manchester*. (Communicated, with emendations and alterations by the author).

it has been used in hundreds of instances, and for many years—namely, the test for animal matter.

Dr. Woods had written on the use of Forchhammer's chameleon previous to the publication alluded to, and about the same time Prof. W. A. Miller; but I am not aware that any one endeavoured to distinguish the various conditions of the organic matter. I am, and was, desirous of showing that organic matter is not necessarily hurtful; we speak of it in water as an evil, to be measured by the balance, whilst there is as much difference in the qualities of that found in water as there is between good wholesome meat and putrid flesh.

I was desirous also of showing the true value of the permanganate, which is capable of acting on one, but scarcely on the other, and of being used for analysis for sanitary purposes, although not for all the demands of the chemist.

Dr. Frankland next took up the subject, and proceeded to show the amount of organic matter, or of sewage matter, which might flow into a stream; and this he did by estimating the nitrogen gas obtainable from the organic matter of the water. By ascertaining the amounts existing in the water supplied to a town and flowing in the sewage, he found the total thrown out by the inhabitants.

For this he made an organic analysis of the residue of the water, and by a very beautiful arrangement, using Sprengel's pump, he drew out the nitrogen for measurement. I do not doubt that this mode adopted by Dr. Frankland will always be useful, and will remain permanent as a method, but not for constant use, on account of the time required, excepting by those chemists who perform many of such analyses, and have the apparatus in constant readiness. It is, however, always pleasant to find an addition made to our capacity for accuracy, and especially when such beautiful methods are employed.

By this means Dr. Frankland obtains the organic nitrogen, nitrates and ammonia being removable. I have not generally estimated the latter, as being still more unstable than the former, and I have frequently found it to disappear with great rapidity, affording by no remnant any clue to the past. Urea and uric acid must also be excluded from the organic nitrogen before we obtain a clue to the albuminous matter. I think, however, that we require to know, above all, whether this matter is in a state to putrefy, or to produce living forms. If there are organic germs capable of development in a visible form, that condition ought not to be neglected.

Immediately, I believe, after this plan was adopted by Dr. Frankland, Mr. Wanklyn discovered a mode of decomposing albumen by permanganate of potash, obtaining ammonia.

This process was used by Messrs. Chapman and Miles Smith. I shall not attempt here to give the exact amount of honour due to those gentlemen, or to tell precisely the boundaries of their labour.

The result seems to be, that the nitrogen may be obtained without the trouble of the usual organic analysis, although it may be uncertain which process takes the longest time.

Mr. Wanklyn considers that he can, by his method, first remove the ammonia which exists as such, by boiling with carbonate of soda; next, by decomposing the albumen with permanganate of potash and boiling in caustic potash, obtain the ammonia resulting from the decomposition. This is a decided gain to us, and may turn out to be the normal mode of separating the ammonia of the putrescible and unputrescible organic bodies.

We are rather apt, when we find a method of analysis, to look at it as final. I shall endeavour to show how much we obtain by Dr. Frankland's method, and how much by Professor Wanklyn's. I shall perhaps, also, as in such cases, be inclined to show that my own method reveals a greater amount of the peculiarities of water. It makes more divisions, is more complicated therefore in one respect; but every point tells its own tale, and it is the number of tales we have to tell regarding the history of water that measures the fulness of our reports. I shall probably adopt all the methods for a time.

In the paper mentioned, I pointed out the error of supposing that organic matter was all equally unwholesome, or that it was, in all cases, even in the slightest degree so. It was the custom too much to confound the simplest peaty and the most noxious putrescible matter. On this subject I may here quote the paper.

"*Quality of the Organic Matter.*

"Water manifestly containing organised matter is to be avoided; but it may frequently be purified by some mechanical mode of separation, such as simple straining.

"If the water contains organic matter in solution, or a condition approaching in all appearance to solution, it may be wholesome or unwholesome. The mere existence of organic matter is no proof of impurity. We must know if it brings animalculæ or vegetable life or products of putrefaction. We must know the *quality* as well as the quantity. If the matter is peaty, consisting of the ordinary humous class of acids and salts, the colour may be very dark and the water very unpleasant to look at, without being in any way, so far as I have ever heard, injurious to health, although such water cannot be quite so wholesome as pure water, since the oxygen of solution is diminished. The taste and other sensible qualities will be the chief guides.

"If the matter is wholly or nearly colourless, it may still be wholesome or unwholesome. It may, for example, contain the juices of plants of a wholesome character. If these juices are fresh, they may do no injury; but they will not long remain fresh, they will putrefy. Water containing organic matter ready to putrefy ought to be avoided, as we cannot tell when the moment of danger begins; whilst the quality at best is never known to us exactly.

"To ascertain the nature of the organic matter, the water is allowed to stand for a day or two, in which case it may be found that organised bodies show themselves.

"Sometimes plants seem completely to fill the vessel, having come out of a moderately clear solution. When standing, in this case, the water must be prevented from evaporating, and it must be in glass, so as to be exposed to light; a temperature suiting vegetation is also to be given. Animalculæ may appear in great numbers; they are an indication of nitrogenous matter, and one proof of the presence of substances capable of putrefaction. It may be that some form of putrefaction will be the only result; but whether this occurs alone, or along with organised forms, an excess of organic matter is proved.

"Water that will not bear the test of standing will in most cases be rejected at once. If no other can be obtained, it ought to be used before the putrefactive process has begun; but this is very dangerous. The next best method is to wait till after putrefaction has terminated, and the products are separated as much as possible. This is popularly known to be the case when the water has for some time become clear and colourless, and free from smell and taste. There are some difficulties connected with this. Water undergoing putrefaction is manifestly unwholesome. After putrefaction is completed, it may be quite wholesome. Although the process is proved by Pasteur not to begin without the aid of organic germs of some kind, they seem to be of a class constantly existing in the atmosphere, even when it is wholesome, whilst we have reason to believe, from the results, that germs of disease, if there are such, are decomposed, like other albumenoid substances, during the action. It would, therefore, be probably safer to wait till putrefaction was completed, but this is often tedious. At any rate, it was intended to state that, when activity began, it was not safe to use the water. The points of safety and of danger require investigation.

"Water with green organic matter in suspension or semi-solution is generally full of germs of living things, and nauseous to the taste.

"A microscope is very useful in detecting the smaller forms of life, but not always essential. Good water is clear and colourless, or only slightly browned by peat. Clear bright water shows no microscopic objects. It is quite a mistake to suppose that all water contains animalculæ. Those who have sent abroad this saying could not have known what pure water is.

"If the signs of organic matter are clear, it may not be needful to go further, but to reject the water at once. After standing for two or three days, varying with temperature, and showing nothing to the eye except a little film of green on the bottom of the vessel, we may conclude that not much organisable matter is there. We may then proceed to the chemical examination."

Some years ago it was customary, more than now, to examine with the microscope water intended for the use of towns. Attempting at one time to join the chemical and microscopic together, as they were too much in separate hands, I came to certain general conclusions:—That no ordinary pure water produced much vegetable or animal life, and that microscopists were mistaken in allowing people to suppose that every drop of water was inhabited; that nevertheless water, generally considered very pure for drinking, might contain some forms not possessed with distinct locomotion; that whenever distinct locomotion began, especially among soft-bodied forms, the water was more than suspicious; that forms increased with the quantity of organic matter containing nitrogen, until the amount was so great as to cause gases of decomposition which eventually stifled life. How far this stifling of life proceeds I do not attempt to say. I suppose it will not apply to the mucedines, which cause putrefaction to commence.

If the water was impregnated with sewage water (as the Thames at London, for example), bad cases excepted, the amount of vegetation which spread over the sides of a bottle filled with it and set in the sun, was so great as to give the appearance of one solid mass. If the water were taken from the river above Reading, the amount of vegetable matter was seen as a delicate green colouring at the bottom of the vessel; and if it were taken up at the source, no greenness whatever appeared, but, after long standing, minute crystals of limestone. If the water contained sewage, the phosphates and magnesia were generally found collected in some form of the *Navicula*, frequently in large groups of the *Navicula fulva*, and with it also was found phosphoric acid and magnesia. It was sufficient to note the condition of the water with relation to these deposits to ascertain at what part of the Thames the specimen was taken; and without the examination of these deposits, I do not consider that it would have been possible to obtain a distinct idea of the nature of the organic matter present. It is, however, needful that we know the general character of the water; had we a specimen from another situation and found no deposit whatever, it would have been very unfair or very unwise to conclude that it was similar in quality to that from the source of the Thames. It might have been saturated with nitrates, and even a large amount of organic matter not capable of taking the forms alluded to. Perhaps, however, nitrates prevent decay in water as in meat. As the germs of the lower forms of life may pass by us unobserved, it is necessary that we should give them time for development, in order that they may become sufficiently prominent to attract our attention. For this reason I consider it an imperfect examination of water when this is not attended to, in cases at least where we have not the slightest idea of the nature of the water. We find water with less than two grains of organic matter per gallon giving rise to forms by no means agreeable to look at in our food, and water with several grains of organic matter giving rise to no such forms.

It is true that we cannot tell which of these living forms are most dangerous; we cannot tell which of them, if any of them, produce either cholera or any other disease; but we can say that water which contains them may contain the elements of disease, whilst water which does not contain them or matter to make them is innocent. So far as this we are obliged to go at present. It was for these reasons that I have not recommended the method of estimating the total nitrogen in water. I was inclined to believe that the danger arising from water could not be measured by the amount of organic matter, or even by the amount of nitrogen in the organic matter.

Still it is of advantage to estimate the nitrogen of the organic matter, in order to compare the state of one source of water from day to day, as, for example, Dr. Frankland does so frequently in the case of the Thames. It is not, however, the organic matter only that gives out nitrogen; that is given out by ammonia and nitric acid; and these must also be estimated when seeking albumenoids. And this course is adopted by Profs. Frankland and Wanklyn.

We may now inquire how far all these bodies together will give us the amount of the organic matter falling into the water.

When azotised compounds decompose and form ammonia, how long is this ammonia retained in the water? On examining a very putrid stream, I estimated the amount of ammonia at the most putrid portion, where carburetted hydrogen was passing off in great volumes, and where a cubic foot could be obtained in a very few minutes by stirring.

In the sewage stream of which I have spoken, the amount of ammonia was from 0·5 to 0·7 grain per gallon. After going 14 miles, the amount was only 0·07, and, after 20 miles, none at all was found. To say none at all, is to go far, but it was not found by the mode adopted for the others.

The mud of the same stream was in a state of putrefaction, and contained, per cent—

Ammonia	0·797
,, a mile lower	0·420
,, at second mile	0·171

The ammonia rapidly disappeared, and the mud itself dlminished very greatly in amount.

I estimated that one grain of ammonia evaporated, in some seasons, from every square foot per hour.

In taking sewage water to the land, I think it very important that the movement should be as rapid as possible.

The water, in its passage of 20 miles, has lost its valuable ammonia, and that within two or three days. This is a sufficient proof that we must not trust to the ammonia as an indication of the amount of the organic matter which has been present, as it is as rapidly removed as the organic matter is decomposed; that is to say, the length of time necessary for complete putrefaction is, under favourable circumstances, no greater than the time afterwards required for the removal of its products. In enquiries on putrefaction, I have found the temperature 12·2° C. a marked one. Putrefaction may be said to begin actively at that point, and the results here given would, probably, be very different below that. In this water there was no moving life to be observed; but the estimation of the organic matter would have shown no difference, whether vitality had been present, and the substance had been capable of entering into active and unwholesome forms, or had been ready to break up into instantaneous putrefaction, or had been preserved, like a mummy, in carbolic acid for a thousand years.

From this observation regarding the ammonia, we are clearly led to beware, in our schemes of irrigation by sewage water, that the land shall be overflowed before the ammonia is thoroughly formed, or else, if the ammonia is formed, that it shall not be subjected to loss by long exposure to evaporation.

We see, also, that nature provides here for the complete obliteration of organic matter. It ceases altogether to be found in the water. It may be traced, either as such, or as ammonia and carbonic acid, long after the bubbles of carburetted hydrogen have ceased to appear, until, at last, it dwindles down to an amount which is rather difficult to remove from water, and which, so far as we know, may be utterly disregarded.

In the passage of organic matter, we may observe, from figures soon be to quoted, that the volatile and organic matter diminished from 9·33 grains per gallon down to 5·04, even when there was an increase of fixed matter, and that the decomposing matter in solution diminished still more rapidly, in the ratio of 283 to 17. The use of the word decomposing matter is not quite correct; it means the substances in solution, arising from decomposing matter and absorbing oxygen at once. It must be observed that the time required was two to three days; and I may add that I could not have drunk the water at last, but there was great foulness to begin with. Still, it shows great removal of impurity.

The organic matter having left the water, we may next enquire whether any trace of its existence remains behind. That trace we do find in the increased amount of alkalies, sulphates, and chlorides.

The alkalies and alkaline salts, but especially common salt, are prominent. The whole of the common salt which has been used as food, without the slightest loss, is found in water, when vegetation has not removed it. The sulphur has become partly oxidised, leaving sulphates, whilst some may have left in company with hydrogen. Phosphates have been increased for a time; but they rapidly fall, taking lime and some magnesia with them; and, on the whole, the great change to be observed in the water is connected chiefly with the alkaline salts. The most stable and most constant of these, without loss, is common salt.

On this subject, I may quote what has been said elsewhere regarding the chlorides as an indication of the presence of animal matter, proper regard being had to the absence of other sources, which, in this country, are chiefly connected with artificial circumstances. "The absence of the chlorides, especially, may be considered as the certain absence of sewage matter, and their amount to be estimated as an indication of the comparative amount of sewage matter from day to day, in cases where sewage only pollutes the river." I conclude from these data that the organic matter and the nitrogen in it are equally incapable of giving us a sufficient history of the water. We may draw another conclusion, that nature has provided a mode in certain conditions for its perfect removal.

It is worth while to ask whether this purification by putrefaction is not the most complete method; it seems to destroy that which we consider to be germs, which germs may be a beginning of any disease of the most terrible form. Having read most that I can find on this subject, I have been led to think that the water, before and during putrefaction, may contain the diseases that have been washed from cities, but that the air above, containing the gases and vapours, does not contain the germs of these diseases, although, of itself, it is extremely loathsome and decidedly unwholesome. It is rapidly purified by the atmosphere. However, I reason from the facts obtained by others, since disease is not my study. After complete putrefaction and clearing, the water seems to be used with impunity. Our rivers, however, seem too small to purify large quantities in their course, as, even in warm weather, the time must be measured by days if the specimen given is a fair one. I do not pretend to say how much may be allowed to go into a river of a given size without fear, but this may be found, as, after all, every river has some sewage from animals, and, in this country, even from man also.

If the water were allowed to clear itself by standing, producing whatever amount of organic life could be developed from it, the germs might be increased in number, instead of being diminished. It is proper to observe that the liquids must be included. The solids contain little chlorine. The water above might remain very clear, but might be, nevertheless, very dangerous. In such a condition, water seems to be best purified by filtration through the soil, which simply means extremely slow and careful filtration, accompanied with partial oxidation; in that case, the water coming from under the soil would be fit again for use, although it would contain, and does contain, the alkaline salts alluded to.

Waters from rich lands, unless from very deep drains, always contain more organic matter than water from hills, and more albumen, or matter so conditioned that it is capable of assuming a great variety of living forms with and without locomotion. Water from the hills of Scotland and Wales, Cumberland, and many parts of North England, gives rise to no variety of living forms; and, in many of them, there is scarcely anything to be remarked in the deposit, unless opportunity is given for collecting it from a large quantity of water, and concentrating. On studying this subject many years ago, I found that, in some of those cases where the water was peaty, there was also to be found a large amount of ammonia. The words I used were these:—"In a peat bog which is not well drained, and is, therefore, wet and cold, the acids of the peat do not become dissolved so as to form a very deeply coloured solution, but they form a solution of a pale yellow. But in grounds which are warmer, or, what is better, well drained, the amount of soluble matter is very great. The colour of such water is not to be confounded with the water which heavy showers bring down, filled with mud and bits of peat; it is often perfectly clear and bright, but brown like coffee. The acids in solution at such times are kept so by the presence of ammonia. Ammonia dissolves them in large quantities, and along with them also the salts which they form with lime, magnesia, soda, phosphates, &c.

"Plants begin to grow in warm weather; at this time ammonia is formed. It is at this time the organic matter decays, and, in its approach to inorganic matter, passes through this stage of ammonia.

"The peat mould Mulder has shown, but he has not mentioned this excess of ammonia."

I supposed at the time, as it appears, that the ammonia produced by the decomposition of vegetable substances was used for the solution of the ammoniacal humates of Mulder. The paper read was only a short note intended to call attention to an important and curious point—the amount of ammonia on those bare hills. I have had the subject before me frequently since that period, namely, 1847, but have never given it all the time required for its elucidation. Lately, Professor Wanklyn and Messrs. Miles Smith and Chapman have examined the hill-waters, and have rather alarmed the public by informing them that they contain more albumenoid matter than waters coming from rich plains. The process they adopted has, no doubt, shown two conditions of the nitrogen; and it is possible that one may be albumen; but it seems perfectly clear that it is not putrescible albumen. I had long ago found the nitrogen; it still remains to find out all the conditions of its existence, If waters containing nitrogen from the hills are allowed to stand, they neither show their nitrogen by the production of living forms in proportion to the amount of that element, nor by putrefaction; any fear, therefore, of such results may be entirely put out of our minds. The living forms, which are the most dangerous, are fewer than from pretty deeply filtered water of the plains; and putrefation cannot exist when the matter to putrefy is so minute: when the solutions are extremely weak, oxidation overpowers it. Such, at least, is my experience.

A reason for believing that nitrogen exists as albumen is the large amount of fish which the water supports. But protein exists in many conditions. The learned originator of the word had the idea of the prophetical and changeable Proteus in his view, as well as the rank of the substance as first in importance, because it forms man. I think, however, the probability is that the earth acids keep it from change, united to the generally low temperature on the hills. This latter, however, does not seem needful. These soils saturated with peaty water are not to be compared to flat, wet, and ague-bringing grass and other lands. I find the process of Professor Wanklyn still more valuable since I wrote the above, although I adhere

to the reasoning that, although he may be right in believing albumenoids to be present, the water is not, to that extent, hurtful. The same applies to the reasoning, as I understand it, of Dr. Frankland. But we need not quarrel; it is enough if we each try to elucidate the subject.

(To be continued).

ON THE PROXIMATE ANALYSIS OF COALS.*

By Prof. GUSTAVUS HINRICHS,
Chemist of the Geological Survey of Iowa.

DETERMINATION OF THE MOISTURE.

A FLAT-BOTTOMED iron pan, of 20 centimetres in diameter, was filled evenly to the depth of 1½ centimetres with sand, and the latter was covered with a copper plate, on which the watch glass containing the coal was placed. A thermometer (scale to 370° C.) was, by means of a rubber stopper, inserted in an iron arm of the tripod supporting the iron pan, and held with its bulb about half a centimetre above the copper plate. By means of a Bunsen burner it was found very easy to keep the thermometer perfectly constant at 115° C. This apparatus I consider a good substitute for Fresenius's iron plate.

The coal to be dried was finely pulverised, direct experiments having convinced me that the application of fragments was not only very much slower, but also erroneous, on account of the peculiar property of bituminous coal treated of below.

In order to show the accuracy of this method, I transcribe the following examples from my journals:—

No. of Coal.	Weight of Portion.	Time.	Moisture. Per cent.	Deviation from Mean.	Mean.
390 e	0·961	1 hour	4·888	−0·004	4·892
,, f	0·919	1 ,,	4·896	+0·004	,,
,, e	0·961	2½ ,,	4·160	+0·010	4·150
,, f	0·919	2½ ,,	4·140	−0·010	,,
339 e	1·452	1 ,,	8·260	+0·070	8·190
,, f	0·975	1 ,,	8·120	−0·070	,,
,, e	1·452	3 ,,	7·160	+0·170	,,
,, f	0·975	3 ,,	6·830	−0·160	,,
338 e	1·415	1 ,,	3·852	−0·029	3·881
,, f	0·805	1 ,,	3·911	+0·030	,,
,, e	1·415	2½ ,,	3·287	+0·123	3·164
,, f	0·805	2½ ,,	3·042	−0·122	,,
,, e	1·415	5½ ,,	2·722	+0·088	2·634
,, f	0·805	5½ ,,	2·546	−0·088	,,

These results—a few taken from among a great number of determinations—show that the loss (called moisture) decreases regularly after the first hour of drying, that is to say, while the coal loses in weight during the first hour, it steadily gains in weight thereafter. It appears, furthermore, that the accuracy of a determination, expressed in the smallness of the deviations from the mean, is greatest at the end of the first hour of drying, least after about three hours of drying, and thereafter increases again, as expressed in the diminution of the deviations after 5½ hours' drying in coal No. 338.

On account of these peculiar properties of our bituminous coal, I put down as *moisture* the loss in weight of the finely-pulverised coal after one hour's drying at a temperature between 105° and 110° C.

ON THE SLOW OXIDATION OF COAL.

This increase in weight after the first hour's drying I have found in all Iowa investigated as yet. I have also found it to occur in a sample of coal (Steinkohle) from Benthen, Silesia, which showed a loss of 3·62 per cent at the close of 1 hour, and in 4 further hours' drying gained again 0·42 per cent. It was not noticed in brown coal from Bilin, Bohemia, nor in anthracite from Pennsylvania. I am, therefore, inclined to believe this to be a property peculiar to pit-coal (steinkohle).

On page 401 of vol. 1, p. 1, of the "Iowa Geology," Professor Whitney remarks: "A remarkable fact in connection with the determination of the water present in the specimens of coal has been noticed. In numerous instances, after the sample, in the form of a coarse powder, had been dried for several hours in the air bath, at a temperature a little above that of boiling water, during which time it had gradually lost weight until all the water seemed to have been expelled, on continuing the operation for some time longer, a slight increase of weight would become perceptible, and the coal would continue to grow heavier, until a gain of several tenths of a per cent of the original weight had been made. This appears to be owing to the slow oxidation of the sulphur which all these coals contain in a finely divided state, disseminated in invisible particles through the mass, and, perhaps, partly in combination with iron."

It is evident that Professor Whitney failed to discover this property as a general one, because he had the coal in coarse fragments. The want of correspondence in the results of determinations of moisture in the same sample, dried at the same time, but of different weights, made me apply the coal in the form of powder. Thereby the turning point was reduced from "several hours" to less than one hour, the "numerous instances" extended to all samples investigated, the "slight increase of several tenths of 1 per cent" became often 2 and even 4 per cent! Instead of numerous exceptions we now discovered a general law.

We have failed, as yet, to notice any "sulphur" disseminated through the Iowa coal; what popularly is called sulphur is pyrites. Professor Whitney has given no proof of the existence of real "sulphur" in the coal. It is, therefore, unsatisfactory to ascribe this property of the bituminous coals to such "sulphur."

Pyrites might well be the cause of this phenomenon; the red ashes obtained in many cases (in Van Buren county, Iowa, invariably from the upper part of the coal bank) may well be ascribed to pyrites disseminated through the coal in invisible particles. Two FeS_2 will give Fe_2O_3, $+4SO_3$ by exactly doubling their weight.

In order to decide the question, I select the following results from my analyses:—

INFLUENCE OF TIME OF DRYING.

Top coal ..	No. of samples,	4	3	2	
	Time of drying,	2	3	4—5	hours.
	Mean gain, p.c.,	0·45	0·71	0·96	
Bottom coal ..	No. of samples,	3	5	2	
	Time of drying,	2	3	4	hours.
	Gain, per cent,	0·49	0·50	0·96	
Mean of above.	No. of samples,	7	8	4	
	Time of drying,	2	3	4—5	hours.
	Gain, per cent,	0·46	0·63	0·96	
	Gain, per hour,	0·23	0·21	0·24	

or, on the whole, for 19 samples of coal, very nearly proportional to the time, this being not more than four hours. It also appears that no essential difference is apparent in regard to the position of the sample in the coal bank.

By this means we may compare the following determinations, referring to two, three, or four hours drying. We find:—

Coal. Place—No.	Time. hours.	Increase, Total.	Per ct. per hr.	Difference.	Colour of Ashes.
top 390	2	0·75	0·38		pale brown.
				0·22	
bottom 384	2	0·35	0·16		white.
bottom 395	4	0·80	0·20		red and white.
				0·04	
top 375	4	0·64	0·16		white.
top 346	3	0·68	0·23		reddish brown.
				0·08	
bottom 371	3	0·45	0·15		white.

* Communicated by the author. For a previous paper on this subject see, also, vol. xviii., p. 53.

Coal. Place—No.	Time. hours.	Increase, Total.	Per ct. per hr.	Difference.	Colour of Ashes.
top 336	3	0·76	0·25		gray.
				0·06	
bottom 334	3	0·58	0·19		gray.
top 333	3	1·17	0·39		pink.
				0·09	
bottom 340	3	0·91	0·30		light gray.
middle 357	3	0·55	0·18		white.
				0·03	
top 370	3	0·46	0·15		reddish.

Except in the coal from the last mine, we notice that the more ferruginous ash does correspond to a slightly greater increase in weight; but we notice also that this difference is but very small as compared to the total amount of increase, being only 1-5 to 1-3 of the whole. Arranging these coals in the order of this hourly increase, we find the colour of the ashes not at all forming a regular series from white to red, as it ought to be, if this increase was mainly depending upon the oxidation of the pyrites. Besides, the mean of the four white ash coals is 0·16 per cent hourly increase, while the mean of the four coals showing the greatest increase is only 0·33 per cent, or double the former.

Coal.	Increase, per cent.	Ash.
333	0·39	pink.
390	0·38	pale brown.
340	0·30	light gray.
336	0·25	gray.
346	0·23	reddish brown.
395	0·20	red and white.
334	0·19	grey.
357	0·18	white.
375	0·16	white.
384	0·16	white.
371	0·15	white.
370	0·15	reddish.

The greater increase of the pyritiferous coals is accounted for by the oxidation of the pyrites they contain; the comparatively great increase of coals giving a pure white ash seems to force the conclusion upon us that the bitumen of the coal itself oxidises, and that to this oxidation the main increase of all these bituminous coals must be ascribed. Remembering, now, our result regarding the deportment of bituminous coal from Silesia, anthracite from Pennsylvania, brown coal from Bohemia (all of which gave ashes very nearly of same shade, and all of which had been in my air-heated laboratory for two years), it seems not unlikely that this is another characteristic chemical difference between bituminous coals and other fossil coals.

In conclusion, I will give only two additional determinations, showing a very considerable increase in weight, and also that the process of oxidation is completed in about six hours for two-thirds grammes of coal. For No. 329, containing 8·30 per cent of grey ashes, gained in 5½ hours 2·05 per cent of its original weight. Coal No. 348, with 6 per cent red ashes, weighed 0·693.

			Change. Weight.	Per cent.	Total loss Per cent.
After ½	hours,	0·630	loss	0·063—9·091	9·091
,, 2	,,	0·625	,,	0·005—0·722	9·813
,, 5½	,,	0·656	gain	0·031—4·474	5·339
,, 8½	,,	0·656	,,	0·000	5·330

Determination of the Ashes.

The best way to determine the ashes in coal I found to be the coking of the finely pulverised coal in a small platinum dish (weighing about 8 grammes) with subsequent incineration of this coke in the same vessel. The incineration takes place with great ease and rapidity, and the results are perfectly satisfactory. Thus 3·022 grammes of coal No. 333 gave 2·25 per cent, and 5·263 grammes of the same coal gave 2·58 per cent, deviating from the mean 2·46 by + 0·11.

In regard to the ashes of our Iowa coals, I have found that they are very much more uniform in their distribution throughout the coal fields than usually thought possible. In Van Buren county I find the "bottom" coal giving a white or light coloured ash, the "top" coal of the same bank a red-coloured ash, a fact which I intend to make use of in a subsequent paper on the origin of our coal. I also find the amount of ashes to increase quite evenly (in this county) toward the margin of the coal field from about 2 to 7 per 100 combustible.

Determination of Specific Gravity.

Coarse fragments, freed by means of a sieve from all small particles, and averaging 1-10th cubic centimetres in volume, were introduced into a fifty-gramme flask provided with thermometer stopper. The constants for this flask for temperatures varying from 50° to 80° F. had been carefully determined.

The given specific gravity corresponds to the coal perfectly soaked, so that all its pores were filled with water. That required, on the average, 12 hours, permitting two determinations per day, one in the morning, another in the evening.

That this is not at all trifling may be seen from the following example:—2·760 grms. coal (No. 350) gave the specific gravity 1·309 at 64° F., immediately after filling the flask with water; after about 12 hours' soaking, the specific gravity had increased to 1·328, for the same temperature. According to this latter determination, a cubic foot of this coal would weigh 82·76 lbs.; according to the former, only 81·58, or 1·18 lbs. less. This shows a considerable degree of porosity of the coal, and indicates the absurdity of giving the weight in pounds of a cubic foot of coal with four decimals, although no statement in regard to temperature or time of weighing is made! Such accuracy we meet with in some of the official reports!

Calculation of Results.

Referring to my previous paper (CHEMICAL NEWS, vol. xviii., p. 53), it may be sufficient here to state that, besides the percentage composition of the coal, it is proper to reduce the composition to the combustible = 100, in order to obtain a proper comparative estimate of the character of the fuel itself (in regard to the proportion of bitumen and carbon), and of the amount and quality of the impurities (ashes and moisture). It has also been shown in the paper referred to, that, for considerable areas of the coal field, the sum of the constituents on the scale of combustible = 100 is the proper caloric equivalent, and that the percentage of the combustible in the fuel gives a proper estimate of its value.

According to this method, a considerable number of analyses of Iowa coals have already been made, and a greater number are yet to be executed. It is believed that the results will be strictly comparable for the entire coal-field of Iowa, and that the conclusions, both practical and theoretical, will deserve some confidence.

A New Alloy (says *Iron Age*), forming, we are told, a beautiful white metal, very hard and capable of taking a brilliant polish, is obtained by melting together 70 parts of copper, 20 of nickel, 5⅛ of zinc, and 4⅛ of cadmium; it is, therefore, a kind of German silver, in which part of the zinc is replaced by cadmium. It is used largely in Paris for the manufacture of spoons and forks, which resemble articles of silver.

Amalgamation of Zinc for Galvanic Batteries.—In a somewhat lengthy, and not by any means very lucidly written, paper in *Les Mondes*, M. D'Almeida has described a series of experiments made by him with amalgamated zinc and other metals, and, moreover, with polished substances, such as glass, to prove that the cause of the very far less rapid solution and attack of zinc and other metals when placed in contact with acids, which, unless the said metals were amalgamated, would rapidly corrode and dissolve the same, is due, after amalgamation especially, to the physical change of the surface of the metal, and, as a consequence thereof, the adhesion to the metal of a thin layer of very minute bubbles of hydrogen gas retained to that surface by capillary action, and, as a consequence of their presence, the non-immediate and direct contact of the metal with the acid it is immersed in, but action of the latter upon the former through a layer of very minute bubbles of gas, which appears to be one of the causes of the slower corrosion of amalgamated zinc. The author has made a series of experiments, too long to be described in detail, which, certainly as far as the description goes, appear to prove his theory on this subject.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

June 3rd, 1869.

Dr. W. A. Miller, V.P.R.S., &c., in the Chair.

The minutes of the preceding meeting having been read and confirmed, the following certificates were read:—

For the first time—John Morrison, Analytical Chemist, County Wicklow, Ireland; W. G. Lewis, Fellow of Oriel College, Oxford; Alfred Dudley Keightley, Gatcheck Gunpowder Mills, Old Hall, Milnthorpe, Westmoreland.

For the second time—Temple A. Orme, Teacher of Chemistry and Experimental Physics in University College School; W. Fletcher Barrett, Lecturer on Pysical Science at the London International College.

For the third time—William G. Valentin, Assistant in the Royal College of Chemistry, 126, Lancaster Road, Notting Hill; Thomas Gilham Hewlett, Surgeon, Bombay; Captain A. Noble, Engineer, Elswick Ordnance Works, Newcastle; H. Stillington Grey Stephenson, B.A., Oxford, Sympsham Rectory, Weston-super-Mare. The last-named gentlemen were balloted for and duly elected.

Mr. Gerstl was proposed as an associate of the Society.

The President (Dr. Williamson) then read a lecture on "*The Atomic Theory*," but, as it is difficult for us to give a condensed report which will do justice to so important a subject, and as the author has, with his usual courtesy, kindly promised to send us an abstract, we postpone our report of this paper for a future number.

The Chairman proposed a vote of thanks to Dr. Williamson, and said that it would be better to defer the discussion until the next meeting. He would, however, remark that those who opposed the atomic theory must explain how, according to the notion of the infinite divisibility of matter, they had combination in definite proportion at all. It seemed to him utterly impossible to explain combination in definite proportion by the theory of infinite divisibility.

The President announced that, as the next meeting would be taken up by M. Dumas's lecture at the Royal Institution, another meeting would be held for the ordinary business of the Society; the date was not, however, announced.

The meeting then adjourned till the 17th inst., at the Royal Institution.

NOTICES OF BOOKS.

Spectrum Analysis: six lectures delivered, in 1868, before the Society of Apothecaries of London. By H. E. Roscoe, B.A., F.R.S. Macmillan and Co., 1869.

Lessons in Elementary Chemistry; Inorganic and Organic. By H. E. Roscoe. New Edition. Macmillan and Co., 1869.

Few men are so competent as Professor Roscoe to discuss the various processes and results of spectrum analysis. He has worked much on the subject of light, sometimes alone, sometimes with the men who founded the mode of analysis under discussion: it will also be remembered that he was the first to introduce the subject in a practical form to the attention of scientific men in this country; and he has translated many important memoirs relating thereto into English during the last few years.

The work before us appears at a peculiarly opportune time, since the recent spectroscopic observations of the eclipse of 1868, and the brilliant results in stellar chemistry obtained yet more recently, have made this branch of science perhaps more prominent than any other, whether we look to the novelty and magnitude of its deductions, or to the fact that it enables us to exercise, not alone a cosmic analysis, but a system of analysis embracing the universe.

Starting with Newton's discovery of the composition of white light, Professor Roscoe passes to the consideration of the properties of sunlight, and of the various coloured rays composing white light. The key-note of the whole subject was struck by Newton, in 1675, in the demonstration that "lights which differ in colour, differ also in refrangibility;" he proved, at the same time, that light which has once passed through a prism cannot be further decomposed, and that the various coloured rays constituting white light, when brought together again after decomposition, form white light. The author next considers the various conditions of different portions of the spectrum, and gives illustrations of the fact that the calorific intensity of the spectrum attains a maximum near the red end of the spectrum, while the chemical intensity culminates near the violet end of the spectrum. An account of Fraunhofer's lines concludes the first lecture.

A noticeable feature of the work is the addition of an appendix to each lecture (often exceeding in length the lecture itself), in which extracts from the more important of the memoirs quoted are given, and the most recent discoveries—too late for insertion in the text of the lectures—are described. In the appendix to the first lecture, a lengthy extract is given from Newton's "Optics," regarding the *modus* of the original experiment on the decomposition of light. There are, also, some remarks on the application of magnesium wire as a source of light for photographic purposes, in the course of which it is stated that "a burning magnesium wire, of the thickness of 0·297 millimetre, evolves . . . as much light as seventy-four stearine candles of which five go to the pound."

The second lecture treats of the spectrum of incandescent solids and gases, and the method of producing and examining their spectra. In speaking of the delicacy of the method of spectrum analysis, it is stated that 180,000,000th part of a grain of sodium can be readily detected; 6,000,000th of lithium, and 1,000,000th of strontium. Among the more important results produced by this branch of the subject, is the discovery that lithium, previously known to exist in but four minerals, is now found to be one of the most widely-distributed metals. An interesting account is appended to this lecture of Bunsen and Kirchhoff's mode of working with the spectroscope.

The third lecture contains an historical sketch of the rise and progress of spectrum analysis, and an account of the various new elements discovered by its means. We learn from this that, so far back as 1822, the spectra of many-coloured flames were examined by Sir J. Herschel. On page 96, elaborate analyses are given of the mineral waters in which cæsium and rubidium were first discovered. The lecture concludes with an account of, perhaps, the greatest application of spectrum analysis to the purposes of the manufactures which has yet been made, viz., its application to the process of making steel by the Bessemer process. In this operation, it is of the utmost importance that the operation of blowing air through the molten metal should be stopped the instant that the proper amount of carbon has been removed from the metal. "If the blast be continued for ten seconds after the proper point has been attained, or if it be discontinued ten seconds before that point is reached, the charge becomes either so viscid that it cannot be poured from the converter into the ladle from which it has to be transferred to the moulds, or it contains so much carbon as to crumble up, like cast-iron, under the hammer." The precise moment to stop is judged of by examining the flame as it issues from the mouth of the converter, by means of a spectroscope, and the moment that the carbon lines disappear from the field of view, the blast is shut off.

In the fourth lecture, Professor Roscoe discusses the spectra of metals volatilised in the electric arc, a subject which received much attention from Angström in 1853,

he having mapped no less than 32 spectra, while Mr. Huggins has mapped 24. Thalén has recently investigated and mapped the lines of some of the rarer metals; among them, glucinum, thorinum, and zirconium. At page 156 will be found two very admirable maps of metallic lines, from the drawings of Mr. Huggins, and these are followed by extracts from the memoirs in which he describes them.

In the fifth lecture is commenced the important subject of solar and stellar chemistry, an account is given of the discovery of the coincidence of the dark solar lines with bright metallic lines, of Kirchhoff's explanation of the cause of the coincidences and the deduction therefrom of the well-known theory of the constitution of the sun. We find here two very beautiful reductions of Kirchhoff's maps of the solar spectrum, together with the map of Angström and Thalén, of the spectrum from G to H_2 drawn to the same scale. An experiment is described on page 191 in which "a constantly burning black soda flame" is produced by viewing a soda flame through a surrounding shell of soda flame; this is an admirable experiment for a large audience, provided they are not seated on gradually ascending seats, when of course many look down upon the inner soda flame without looking through the surrounding flame. The appendix to this lecture contains a detailed account of the spectroscopic observations of the solar eclipse of 1868.

The last lecture is devoted to the subject of stellar chemistry, and is accompanied by a beautifully coloured map of the spectra of various stars and nebulæ, among them Sirius, and the blue and orange stars of β Cygni. The spectra of Aldebaran and α Orionis drawn to scale are given on page 235; in these stars no less than seventy lines have been observed, and Dr. Miller and Mr. Huggins have detected nine elements in Aldebaran, which, strange to say, include bismuth (not found in the sun), tellurium, antimony, and mercury. Finally, the spectra of comets and nebulæ are discussed, and it is stated that Brorsen's small comet, which is now visible, has been found by Mr. Huggins to give lines dissimilar to those yielded by any substance known on earth. The final appendices contain very lengthy abstracts from the memoirs of Huggins and Miller on stellar spectra, Kirchhoff's elaborate tables of the coincidences of the bright lines in the spectra of the metals with the dark solar lines, and the work is terminated by a list of the principal memoirs on spectrum analysis, divided into three parts. (1) "Lectures or Memoirs Relating to the subject of Spectrum Analysis generally," eighteen in number; (2) Memoirs relating to the Application of Spectrum Analysis to Terrestial Chemistry," ninety-four in number; (3) "Memoirs relating to the Application of Spectrum Analysis to Celestial Chemistry," seventy-five in number.

The great extent of the literature of the subject well indicates the rapid growth (mainly since 1861) of the science of spectrum analysis, and we have in the work before us a condensed account of everything of importance which has been done in connection with it from the pen of a man who who has himself contributed no insignificant labours in this direction. As to the book itself, it is clearly and concisely written, and is in no place unnecessarily complex. The numerous illustrations, together with the maps and coloured plates, tend greatly to simplify the more abstruse matters, and we heartily recommend the book to the general as well as to the scientific reader.

We are glad to notice the issue of a new edition of Professor Roscoe's useful "Lessons in Elementary Chemistry," a work now generally used by the junior classes in those schools (happily on the increase) in which natural science is taught. The present edition contains no less than fifty-six pages more than the edition of 1866, together with a few additional woodcuts; the index is very complete and comprehensive, and the examination questions have proved of service to science masters: we feel assured that this work will continue to occupy the position which it has gained among our school books.

Observations on some of the Fundamental Principles and Existing Defects of National Education. By NEIL ARNOTT, M.D., F.R.S., &c. Longmans, 1869.

IN about 32 duodecimo pages, Dr. Arnott very clearly sketches the outline for a good and useful system of education. The little book opens with what is very aptly called a general map or table of human knowledge, showing the natural divisions. The first embraces the three Kingdoms of Nature; the second the four orders of changes or phenomena among things, the knowledge of which is called Science. The third division is divided into two sections; (*a*) the two arts by which man acquires and stores knowledge; (*b*) industrial arts, fruits of human invention.

This is a comprehensive scheme, but it certainly appears to be the right way. The subjects just enumerated are briefly but lucidly explained and discussed in the subsequent pages of the book, which is a very valuable shilling's worth.

LABORATORY NOTES.

PHOSPHORUS HOLDER.

A FEW inches of lead tube, ¼ in. bore, is contracted to an open cone, at one end. As much phosphorus as one may choose is put into the cone of the tube; the phosphorus is made to project slightly from the cone; the upper part of the tube is filled with water, and corked. Thus is had a phosphorus "crayon" perfectly safe in the hand for luminous writings, &c.

To put in the phosphorus, as much as may be required is melted in a conical glass, or test tube, the cone of which is larger than that of the lead tube.

This is put standing in the melted phosphorus, which fills the cone and tube to its own outside level. When cold, there is a nice projecting crayon, from the form of the glass. Any phosphorus outside the lead tube may be melted off.

To renew the writing point, a test-tube, conical below, is fitted to the cone of the lead; the whole held in warm water for a minute, as much phosphorus flows out as forms a new point.

E. KERNAN.

PHOSPHURETTED HYDROGEN.

THE solution of caustic potash and phosphorus are put into anything like an evaporating basin. On the application of heat, the gas comes off, taking fire at various points of the liquid surface. The cup may be very small, even a watch glass will do.

The basin with its contents may be put aside until required to act again. Even when quite cold, odd bubbles of gas come off.

An objection to this method is that the "rings" do not show; the gas bubbles are too small, and burst before they can unite to form one large one strong enough to overcome the air currents. Could this be effected, the open basin would be a considerable improvement on the retort production of phosphuretted hydrogen.

E. KERNAN.

MISCELLANEOUS.

New Work by Dr. Odling.—Shortly will be published, in 1 vol., "Outlines of Chemistry; or Brief Notes of Chemical Facts," by William Odling, M.B., F.R.S., &c., Fellow of the College of Physicians, and Fullerian Professor of Chemistry at the Royal Institution. This volume will consist of the notes from which the author has lectured for the last six years at St. Bartholomew's Hospital, revised and somewhat extended, so as to furnish the student with a connected outline of the leading facts of chemistry in their relations to each other. It will be essentially descriptive in its character, and aim at calling to mind,

in as few words as possible, the ascertained origins, properties, and metamorphoses of chemical substances. It will include a systematic account of the monad, diad, and triad non-metallic elements, and their principal combinations with each other; of silicon and carbon with its series of methylic, formic, and cyanic compounds; and of the various metals, arranged, as far as practicable, in natural groups, with their respective series of halides, oxides, and oxisalts, &c.

Extraordinary Phenomenon.—The Caspian Sea or Lake is dotted with numerous islands which produce yearly a large quantity of naphtha, and it is no uncommon occurrence for fires to break out in the works, and burn for many days before they can be extinguished. Early last month, owing to some subterraneous disturbances, enormous quantities of naphtha were projected from the wells and spread over the entire surface of the water, and, becoming ignited, notwithstanding every precaution, converted the sea into the semblance of a gigantic flaming punch-bowl, many thousands of square miles in extent. The fire burnt itself out in about forty-eight hours, leaving the surface of the water strewed with the dead bodies of innumerable fishes. Herodotus mentions a tradition that the same phenomenon was once before observed by the tribes inhabiting the shores of the Caspian Sea, which exceeds in area that of England and Scotland together.

Essential Oil of Cochlearia officinalis.—It appears that this essential oil has been frequently confused with the essential oil of mustard, from which the author (Dr. A. W. Hofmann), on experiment, found it essentially different. The boiling point of the oil of *Cochlearia* is at about 160° C., that of the genuine oil of mustard at 147° C. On being treated with ammonia, the essential oil of *Cochlearia* yields a beautifully-crystallising substance (the thiosinnamin of the essential oil of *Cochlearia*), which fuses at 135° C. Analyses of the oil and the ammonia compound just alluded to, prove the oil to be the mustard oil (*Senföl*), of the butyl series—

$$C_4H_9NS = \left.\begin{matrix} C_4H_9 \\ CS \end{matrix}\right\} N.$$

When butylamine (prepared from butyl alcohol by fermentation) is treated with sulphide of carbon and chloride of mercury, a mustard oil is obtained of the same composition and about the same boiling point, but the odour indicated that only an isomeric substance had been obtained, and further research proved that the ammonia compound of the oil, thus artificially produced, had its melting point at 90° C. The author intends to proceed with researches on this subject.—*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we are endeavouring to effect arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

Moniteur Scientifique, No. 299, June 1, 1869.

This periodical contains the following original papers:—

Molecular State of Bodies.—M. Persoz.—This paper is a continuation of a series already published on this subject in the above-named periodical, but far too lengthy and abstruse for abstraction.

History of Urea.—M. Bouchardat.—This is a very valuable essay, but too lengthy and too much condensed already to be fit for this portion of our paper. We may, perhaps, afterwards return to this subject.

M. Margueritte's Process of Sugar Extraction from Molasses.—The leading portion of this lengthy paper is known to our readers; it was published some time since.

Chemisches Centralblatt, No. 19, May 12, 1869.

This periodical contains an original paper—

On the Sulpho-Acids of the Isomeric Hydrocarbons, C_9H_{12}.—M. O. Jacobsen.—Cumolsulphuric acid, $C_6H_3(C_3H_7)SO_3$. The cumol was obtained from cuminic acid, by distillation with five parts of quick-lime. (Boiling point of cumol, 149°—151° C.) It was dissolved in a mixture of equal parts of fuming and ordinary sulphuric acid, next treated with water and carbonate of baryta, and the cumol-sulphate of baryta purified by crystallisation. Free cumol-sulphuric acid is a solid substance, very soluble in water and alcohol, and is decomposed by heat without previously fusing. The author studied the potassa, ammonia, lime, strontia, baryta, zinc, copper, and other salts of this acid. The baryta salt belongs to the more stable of these substances.—Isocumol-sulphuric acid, $C_6H_3(CH_3)_3SO_3$. This acid, in a free state, is likewise a solid substance, deliquescent, and readily soluble in water and alcohol; it fuses, but becomes at the same time decomposed. It forms crystallisable salts with bases.—Mesitylen-sulphuric acid, $C_6H_3(CH_3)_3SO_3$, is also a solid substance, crystallising in six-sided prisms, not deliquescent, readily soluble in alcohol and water, fuses at 100° C., and forms salts with bases, most of which may be obtained in regular crystalline form.—Ethyltoluol-sulphuric acid, $C_6H_4(CH_3)(C_2H_5)SO_3$. Only the baryta and potassa salt of this acid were obtained.—The sulpho-acid of phoron-cumol is a solid substance, readily soluble in water and alcohol; the baryta salt is sparingly soluble in water, and less soluble even in alcohol.

On Ethyldimethylcarbinol.—M. A. Popoff.—This substance—

$$C\left\{\begin{matrix} (CH_3)_2 \\ C_2H_5 \\ H \end{matrix}\right\}O,$$

is a fluid boiling between 98·5° and 102° C., and does not freeze at −17° C. Its percentage composition is—C, 68·18; H, 13·62. On being oxidised with chromic acid, it yields acetic acid only.

Bayerisches Industrie und Gewerbeblatt, No. 2, 1869.

This periodical contains chiefly original papers and communications relating to machinery and mechanical engineering; the only original chemical paper is—

Colouring Matter of Wafers.—Dr. Furtenbach.—Although wafers are at the present day far less commonly used for sealing letters than was the case before the introduction of the machine-made gummed envelopes, the researches on this subject are not without interest. The manufacture of wafers is largely carried on at Nurenberg and Munich, and other towns of Germany, and the samples submitted to research were made in the two places just named. Small bright-red coloured wafers left, on incineration, an ash, consisting of oxide of lead, sulphate of baryta, and some sulphate of lead; another sample of wafers, of very bright red colour, was found to be free from sulphate of baryta, and the lead, having been quantitatively estimated, was found to amount to 46·9 per cent of red lead. White wafers were coloured with sulphate of baryta—no white-lead was found; blue wafers are coloured, partly with ultramarine, and partly with Prussian blue, but contained, in all instances, besides these substances, sulphate of baryta, and, in some cases, some white-lead; pink-coloured wafers contain carmine lake, alumina being found in the ash; brown coloured wafers are tinged with iron ochre; violet wafers were found to be coloured with some violet lac-dye, containing alumina; black wafers are coloured partly with lamp-black, and also with harmalin-black, which, on incineration, left oxide of iron; green coloured wafers are coloured with so-called green cinnabar (chromate of lead and Berlin blue, mixed), also with poisonous copper and arsenical compounds; buff-coloured wafers are coloured with a mixture of oxide of lead, sulphate of baryta, and some oxide of iron.

Journal de Pharmacie et de Chimie, No. 5, May, 1869.

This paper contains the following original essays and papers:—

Formation and Decomposition of Disulphide of Carbon.—M. Berthelot.—Too long and too abstruse for abstraction.

Action of Ammonia upon Phosphorus.—M. Commaille.—The contents of this paper have been already given in an abridged form.

Influence of Pressure upon Chemical Phenomena.—M. Caillet.—Too long for condensation.

Mineral Chalybeate Water from the Département de Maine et Loire.—M. Andouard.—Of local interest only.

The remainder of this number of this periodical is filled with abstracts from the *Comptes Rendus* and other papers already noticed by us.

Journal fur Praktische Chemie, No. 5, 1869.

This periodical contains, in the first place, three papers, by the late Professor Schönbein, on the following subjects:—

1. **Peroxide of Hydrogen as a Medium for Recognising the Ferment-like Properties of Organic Matter.**

2. **Peculiar Activity of One-Half of the Oxygen Contained in Oxide of Copper, and the Dependence thereupon of a Highly-Delicate Reagent for Hydrocyanic Acid and Cyanides.**

3. **Existence of Peroxide of Hydrogen in the Atmosphere.**

We regret that the above essays, though highly interesting, are too long for abstraction; perhaps we may, at a future day, give abbreviated translations of some of them.

On Hydrocarbons.—M. Fritzsche.

On Benzol.—M. Rochleder.

On Catechin and Catechutannin.—M. Rochleder.

Behaviour of Narcein towards Iodine.—M. Stein.—The author has found that narcein is coloured blue by iodine, but only when the alkaloid is in a solid state; for as soon as the crystals of narcein become dissolved, the colouration disappears. None of the other alkaloids of opium behave in the same manner with iodine.

Analysis of an Alloy found at Pompeii.—M. Milan Nevole.—Specific gravity of alloy, at 13° C., 6·66. It contained, in 100 parts:—

Silica, 0·08; lead, 1·12; copper, 55·04; iron, 29·56; antimony, 3·53; zinc, 10·67.

Decomposition of Disulphide of Carbon by Heat.—M. W. Stein.—The author states that the vapour of perfectly pure disulphide of carbon, prepared on purpose for this experiment, was not decomposed when passed through a porcelain tube kept red-hot by a Bunsen gas burner; but, on repeating the experiment, and increasing the heat, by the application of a strong coke and charcoal fire, the inner space of the tube having been filled with broken porcelain, it was found to be lined with a deposit of carbon, owing to the decomposition of the sulphide, while sulphur was collected in a receiver.

Isocitric Acid.—M. Rochleder.—This acid is formed when citric acid in aqueous solution is treated with sodium amalgam, care being taken to keep up an acid reaction of the liquid by the addition of dilute sulphuric acid. The isocitric acid may be obtained pure by a rather circuitous process, and then exhibits a crystalline mass, which has not yet been further investigated; neither have any of the salts it forms been studied.

Polytechnisches Journal von Dingler, second April number, 1869.

This periodical, though chiefly bearing upon mechanical science occasionally contains original communications which are interesting to our readers; from the present number we only abstract :—

Very Durable Cement for Iron and Stone.—M. Pollack, of Bautzen, Saxony, states that, for a period of several years, he has used, as a cement to fasten stone to stone and iron to iron, a paste made of pure oxide of lead, litharge, and glycerine in concentrated state. This mixture hardens rapidly, is insoluble in acids (unless quite concentrated), and is not affected by heat. M. Pollack has used it to fasten the different portions of a fly-wheel with great success; while, when placed between stones, and once hardened, it is easier to break the stone than the joint.

First May number, 1869.

The greater number of the papers of the present number relate to mechanical science; we notice briefly :—

Diaphonometer to Determine the Transparency of Different Kinds of Glass.—M. Jicinsky.—Without the engravings, it is impossible to make this instrument understood, but, from what is said about it, it is no doubt a useful instrument, especially as the author has proved that the diaphanicity of divers kinds of glass is not dependent so much on its chemical composition, as on certain physical properties due to the heat applied in making it.

Improvement of Acid Waters often Pumped up from Coal-Pits and Mines.—Dr. Willigk.—The author had an opportunity to analyse a water pumped up from a coal-pit in Bohemia. This water, it appears, was very acid, from acid sulphates and some free sulphuric acid present therein, consequently attacking and corroding the pumping gear and machinery, and seriously affecting the steam boiler wherein it had to be used. No other feed-water being on the spot, the author advised, and with good success, that the water should, previous to use, be filtered over witherite, carbonate of baryta, which happened to be abundantly present in that locality.

Analysis of a Cement Marl.—Dr. Lindenmeyer.—In 100 parts:—Lime, 36·84; carbonic acid, 28·50; silica, 23·24; alumina, 4·30; peroxide of iron, 1·14; magnesia, 0·96; potassa, 1·48; water, 2·45. Of this quantity, 29·16 per cent was insoluble in hydrochloric acid.

Volumetrical Estimation of Sulphuric Acid.—Dr. A. Clemm.—After reviewing the methods of R. Wildenstein and Carl Mohr, applied for this purpose, the author describes his mode of operating at length. Briefly stated, his method is the following :—The solution to be experimented upon is coloured with litmus, and very carefully neutralised; a solution of chloride of barium of known strength is added in excess, and all the sulphuric acid thereby precipitated. Next, a titrated solution of carbonate of soda is added, in order to precipitate the excess of baryta; and next, again, the excess of soda solution used is estimated, volumetrically, by means of a titrated dilute sulphuric acid. During these operations, no salt is formed which can injure the colour of the litmus. In case salts might be present in the original solution, the bases of which could be precipitated by carbonate of soda, that precipitation is performed previous to the addition of soda. The filtrate, which contains the sulphuric acid combined with soda, is neutralised, and again volumetrically titrated. The solutions required for this experiment are :—A solution of chloride of barium, containing 52 grms. to the litre of water; a solution of carbonate of soda, containing 26·5 grms. of this salt to the litre of water; a solution of sulphuric acid, containing 20 grms. of strong sulphuric acid to the litre of water. These solutions agree among each other, drop for drop. The advantage claimed for this method is the non-necessity of having to wash out the sulphate and carbonate of baryta, and also the advantage that titration does not take place in a fluid rendered turbid by therein-suspended sulphate of baryta, which always tends to render the observation of colouration of litmus more difficult.

Experiments on the Direct Decomposition of Sulphide of Calcium as met with in Soda Waste by means of Chloride of Manganese.—Dr. Richter.—The author has instituted experiments with the view to obtain, directly, the sulphur in such a state as to render its extraction, by means of sulphide of carbon, an easy matter. Although he has not succeeded quite so well as he desired, he says he hopes his experiments will be repeated by others on a larger scale.

Cryolite Glass, or so-called Hot-Cast Porcelain.—M. Benrath.—The specific gravity of a sample obtained by the author, director of the Imperial Russian Plate-Glass Works at Dorpat, from the American Hot-Cast Porcelain Company, was found to be 2·471. Composition, in 100 parts :—Silica, 67·07; alumina, 10·99; peroxide of iron, 1·02; protoxide of manganese, 1·09; lime, traces; soda, 19·38.

Annalen der Physik und Chemie, von J. C. Poggendorff, No. 3, May 15, 1869.

This periodical contains the following original essays, chiefly relating to mathematico-physical subjects, and hence too abstruse for abstraction :—

Construction of Galvanometers to be Applied when Electric Discharges take place, and on the Way Followed by Electric Co-Currents (Nebenstrome).—M. E. Edlund.

Compounds of Tantalum and Niobium.—M. Rammelsberg.—This is the concluding portion of a lengthy essay on this subject.

Reproduction of Siemens's Unit of Resistance.—M. von Dehms.

Mineralogical Miscellany.—M. von Rath.—*Angles of the Vivianite System.—Chemical Formula of Silicate of Bismuth.* Eulytin contains, in 100 parts :—Oxide of bismuth, 69·38; Silica, 22·23; phosphoric acid, 3·31; peroxide of iron, 2·40; oxide of manganese, 0·30; hydrofluoric acid and water, 1·01; total, 98·63. The specific gravity of this mineral, at 17° C., is 6·106; formula, according to this author—

$$6BiO_2Si_2O_3 + \left\{\begin{matrix}BiO_3\\Fe_2O_3\end{matrix}\right\} PO_4 + BiFl.$$

Crystalline Form of Atelestite.—Labradorite from Närödal, near Gudvangen.—Boulangerite from the Argentiferous Sand near Mayen. This mineral is made up according to the formula $3PbS,Sb_2S_3$, and contains, in 100 parts :—Sulphur, 18·21; antimony, 22·83; lead, 58·96. *—New Crystalline Alloy of Zinc and Calcium.* This alloy contains, in 100 parts :—Zinc, 95·13; calcium, 4·87. Formula, $Zn_{12}Ca$; crystalline form, quadratoctahedron; specific gravity, 6·3726; when in contact with water, hydrogen is at once disengaged by this alloy.

Collections of Meteorites.—M. Buchner.

New Sulpho-Salts.—M. R. Schneider.—Sulphide of potassium and iron, $K_2Fe_2S_4$, in 100 parts :—Potassium, 24·59; iron, 35·19; sulphur, 40·22. Sulphide of potassium and bismuth, $K_2Bi_2S_4$, in 100 parts :—Potassium, 12·57; bismuth, 66·85; sulphur, 20·58.

Galvanic Relations of Palladium.—M. Poggendorff.

Simple Expression for the General Fundamental Principles of Electric Action.—M. Weber.—A mathematical essay.

Galvanic Resistance of Liquids.—M. Paalzow.

Minerals met with in the Baryta-Bearing Gangue of Wittich, in the Duchy of Baden.—M. Petersen.—Analysis of *Wittichenite.* Specific gravity, 4·45. It contains, in 100 parts :—Sulphur, 20·30; arsenic, 0·79; antimony, 0·41; bismuth, 41·13; iron, 0·35; copper, 36·76; silver, 0·15; zinc, 0·13.—*Epigenite.* In 100 parts :—Sulphur, 31·57; arsenic, 12·09; bismuth, 2·12; iron, 13·43; copper, 40·32; traces only of silver and zinc.—*Magnetic Pyrites*, in hornblende. In 100 parts :—Sulphur, 39·93; arsenic, 0·15; lead, 0·10; copper, 0·36; iron, 58·31; nickel and cobalt, 0·63; with traces of titanium, manganese, bismuth, and minute traces of silver.

Specific Gravity of Basaltic Lava.—Dr. A. von Lasaulx.—It appears that this material varies in specific gravity from 1·93 to 2·79. Eight different samples were operated upon, all of which had been previously reduced to a finely-divided powder.

Pharmaceutische Zeitschrift fur Russland, March and April, 1869.

We take these two numbers together, since the leading original paper contained therein is carried through both these numbers. The paper is an essay, bearing the title—

Glycerine: its History, Manufacture, Occurrence, Estimation of Purity, and Various Applications.—J. W. Klever.—Glycerine is met with in some natural oils and fats, also in the products of the vinous fermentation of sugar; hence it is found in wine in small quantity. It does not occur in fats as such by itself; these substances are to be considered rather as ethers. 100 parts of glycerine dissolve of—Arsenious acid, 20 parts; benzoic acid, 20 parts; oxalic acid, 15 parts; bicyanide of mercury, 27 parts; corrosive sublimate, 7·50 parts; alum, 40 parts; arseniate of potassa, 50 parts; sulphur, 0·10 parts; strychnia, 0·25 parts; morphia, 0·45 parts; acetate of morphia, 20·0 parts. The following substances are insoluble in glycerine :—Ether, benzol, camphor, sulphide of carbon, chloroform, the bromide and iodide of mercury, calomel, fatty acids, fatty and ethereal oils. Glycerine is decomposed by chromic acid, bichromate of potassa, and permanganate of potassa.

On the Microscope, and the Discoveries made by it.—M. O. Löwenthal.—This paper contains a short history of the discoveries made by this useful optical instrument, from Antony van Leeuwenhoek's time down to the present age.

Testing Chloroform for the Presence of Alcohol and Ether.—The chloroform should be first treated with fused chloride of calcium, to eliminate any water, next some iodine should be added. If the chloroform is free from either alcohol or ether, the colour produced by the solution of the iodine is bright red; but when either alcohol or ether are present, the colour of the solution is brown. In order to distinguish between alcohol and ether, a small piece of a crystal of fuchsin is added to the chloroform in question; when the slightest trace of

alcohol is present, a deep red solution will ensue. Perfectly pure chloroform yields, with fuchsin, a solution which is only slightly pinkish tinged.

Salt Deposit near Berlin.—M. Jahn.—It appears that there has been discovered near Berlin, at Sperenberg, a rock-salt deposit, which in some localities has a thickness of 669 feet. The locality where this important discovery has been made is within eight miles from the capital city of Prussia, and, from borings instituted, it appears, in every aspect, a highly valuable mineral deposit.

Non-Identity of Caffeine and Theine.—M. Hager observes that, although elementary chemical analysis of these substances yields results which would conclusively prove the identity of these two substances, yet the author found that the physiological effect, after partaking of a dose of 0·25 grm. of both substances, in chemically pure state, and prepared by himself, is by no means the same. The human organism is imbued with testing powers, compared with which chemical reagents are of little delicacy.

On the Ground Nut, Arachis Hypogœa.—M. F. A. Flückiger.—This is a monograph on the subject, and includes the origin, discovery, occurrence, and commercial history of the fruit of a plant belonging to the natural order of the *Leguminosæ*. The fruit is known, in English language, as ground-nut, earth-nut, pea-nut, and manilla-nut; in French as *arachide*, or *pistache de terre*. The plant which yields this fruit is a native of tropical and sub-tropical regions, and belongs especially to Africa. The average weight of the seeds contained in the fruit and bearers of the oil is 0·5 grm.; they yield from 38 to 50 per cent of oil, which consists of a mixture of glycerine compounds and three different fatty acids—arachinic acid, $C_{40}H_{40}O_4$, fusing at 75° C.; hypogœic acid, $C_{32}H_{30}O_4$, fusing at 35° C.; and palmitinic acid, $C_{32}H_{32}O_4$, fusing at 62° C. The seeds contain 28·85 per cent of protein compounds, 13·87 per cent of woody fibre, and 7·16 per cent of gum and sugar.

Sensitiveness of Divers Methods for the Detection of Arsenic.—M. Frank.—Marsh's apparatus admits of detecting 0·0003 milligramme AsO_3, dissolved in 150,000,000 of its weight of liquid; the method of Von Babo and Fresenius admits of detecting 0·002 milligramme AsO_3; Reinsch's method, by means of copper, detects 0·001 milligramme AsO_3, in 5,000,000 as much liquid; Rieckher's method, by means of ammoniacal nitrate of silver solution, detects 0·002 milligrammme in 3,000,000 parts of liquid.

NOTES AND QUERIES.

Rendering Walls Impervious to Damp.—I am at present erecting a new laboratory, and am anxious to get the walls, &c., as impervious as possible to damp. Can any of the readers of the CHEMICAL NEWS tell me what agent is the best to use for this purpose on brick, plaster, and cement? A wash of silicate of soda has been recommended, but I fear the effects of efflorescence afterwards. Would a mixture of silicate of soda with some other agent obviate this? I see several makers of soluble glass advertise in your columns, perhaps they might be induced to answer this question.—BUILDER.

Recovered Grease.—Could any of your readers tell me how to detect recovered grease in tallow.—C. W.

Picrates.—Can any of your correspondents tell me the simplest and cheapest way of making picrate of ammonia and other picrates.—T. E. D.

Scale of Temperatures.—Will any of your numerous correspondents kindly direct me to any good and dependable scale of temperatures at which glasses and metals fuse, comprising all usual silicates of potassa and soda, and such compound metals as have been noted, the object being to obtain a pyrometric guage for temperatures between 900° and 2000° F.—ALFRED PAYNE.

Colour of Vermillion.—It is a fact well known to artists, that the splendidly bright colour of vermillion (cinnabar, sulphide of mercury) has a tendency, especially if it has been mixed with white-lead, to become blackish brown and very dark coloured in a comparatively short time. This tendeney of the vermillion is altogether obviated if, previous to being mixed with oil, it is thoroughly and intimately mingled with about $\frac{1}{4}$th of its weight of flowers of sulphur.

Action of Different Bodies on Sulphuretted Hydrogen.—M. Bœttger remarks that oxide of thallium inflames this gas when coming into contact with it; so do pure peroxide of manganese, peroxide of lead, and peroxide of silver obtained galvanically. With binoxide of barium, chlorate of lead, and chlorate of silver, the gas becomes vigorously inflamed; fulminate of silver also inflames the gas, and the salt explodes. Iodide of nitrogen explodes in contact with this gas, which, under certain conditions, is inflamed by gun-cotton.

MEETINGS FOR THE WEEK.

WEDNESDAY, 16th.—Meteorological, 7. Anniversary Meeting.

THURSDAY, 17th.—Royal, 8.30.

—— Chemical, 8. Inaugural Faraday Lecture by Professor Dumas, in the Theatre of the Royal Institution.

FRIDAY, 18th.—Chemical Society Dinner at Willis's Rooms, at 6.30.

TO CORRESPONDENTS.

*** We shall feel indebted to correspondents who will forward us Reports of Local Meetings of Societies, Chemical Appointments, and any other subjects interesting to the chemical world. We regret that, owing to the increasing popularity and circulation of the CHEMICAL NEWS, and consequent pressure on our space, we are often obliged to delay the publication of long papers. To those correspondents who wish to favour our readers with Notes of New Discoveries, Descriptions of Apparatus, or Answers to Questions, we would especially recommend our Notes and Queries columns.

Professor Attfield's letter shall appear next week.

E. K.—The book is excellent; the price a guinea. Thanks for the notes.

Sulphate of Manganese.—(No. 494, p. 252). A letter is waiting for our querist on this subject.

E. H.—Good medicinal carbolic acid will answer the purpose; add it to the water in which the linen is washed, in the proportion of a teaspoonful of the acid to half a gallon of water.

Messrs. Macniven and Cameron, 23, Blair Street, Edinburgh.—We have received the pens, and like them much. The "Waverley" is as pleasant to use as a quill, while the "Owl" answers well for small, fine writing. The "Pickwick" is also good.

B. B.—We did not speak of the original articles contained in the periodical quoted by you, but only to articles abstracted and translated from other periodicals. We find, on page 308, a paper originally published in June last; several other abstracts are from papers as old as those published in October last year. We will assume your correction of 1868 for 1858 to be correct; but it must be remembered that we do not, unless in special cases, abstract or mention the abstracts from other foreign sources met with in the periodicals we quote. At page 323 is a paper published a year ago at the time the periodical you allude to was issued.

Communications have been received from E. H. von Baumhauer; Macniven and Cameron; Sir William Thompson, F.R.S.; T. Bloxam; E. Kernan; Johnson and Sons; E. Hayes; C. Collins; C. Tomlinson, F.R.S.; C. Williams; A. Payne; R. W. Roberts; H. Fletcher; J. Wallace; E. C. C. Stanford (with enclosure); Mawson and Swan; E. Weston; D. Swan, jun. (with enclosure); H. H. Watson; E. Jones; Dr. R. Angus Smith, F.R.S.; Young and Co.; J. Davis; J. J. Lundy; J. Gregory; J. Riley; W. A. Todd; J. Muspratt and Sons; Kingsbury and Co.; R. D. Grindley; A. Gow (with enclosure); H. Nicol; W. Smith; Evans, Lescher, and Evans; G. G. Walmsley; C. S. Romains; and G. W. Bucklyn.

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THE CHEMICAL NEWS.

VOL. XIX. No. 498.

RESEARCHES ON GASEOUS SPECTRA

IN RELATION TO THE PHYSICAL CONSTITUTION OF THE SUN, STARS, AND NEBULÆ.*

By E. FRANKLAND, F.R.S., and J. N. LOCKYER.

I. THE Fraunhofer line in the solar spectrum, named *h* by Angström, which is due to the absorption of hydrogen, is not visible in the tubes we employ with low battery and Leyden-jar power; it may be looked upon, therefore, as an indication of relatively high temperature. As the line in question has been reversed by one of us in the spectrum of the chromosphere, it follows that the chromosphere, when cool enough to absorb, is still of a relatively high temperature.

II. Under certain conditions of temperature and pressure, the spectrum of hydrogen is reduced in our instrument to one line in the green, corresponding to F in the solar spectrum.

III. The spectrum of nitrogen is similarly reducible to one bright line in the green, with traces of other more refrangible faint lines.

IV. From a mixture of the two gases we have obtained a combination of the spectra in question, the relative brilliancy of the two bright green lines varying with the amount of each gas present in the mixture.

V. By removing the experimental tube a little further away from the split of the spectroscope, the combined spectrum was reduced to the two bright lines.

VI. By reducing the temperature, all spectroscopic evidence of the nitrogen vanished; and, by increasing it, many new nitrogen lines make their appearance, the hydrogen line always remaining visible.

The bearing of these latter observations on those made on the nebulæ by Mr. Huggins, Father Secchi, and Lord Rosse is at once obvious. The visibility of a single line of nitrogen has been taken by Mr. Huggins to indicate possibly, first, "a form of matter more elementary than nitrogen," and which our analysis has not yet enabled us to detect†; and then, secondly, "a power of extinction existing in cosmical space."‡

Our experiments on the gases themselves show not only that such assumptions are unnecessary, but that spectrum analysis here presents us with a means of largely increasing our knowledge of the physical constitution of these heavenly bodies.

Already we can gather that the temperature of the nebulæ is lower than that of our sun, and that their tenuity is excessive; it is also a question whether the continuous spectrum observed in some cases may not be due to gaseous condensation.

* Abstract of a paper read before the Royal Society, June 10th, 1869.

† *Phil. Trans.*, 1864, p. 444.

‡ Ibid., 1868, p. 544.

ON THE ELECTROLYSIS OF NITRATES.

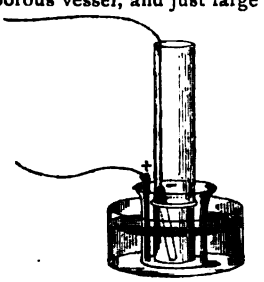
By THOMAS BLOXAM,
Lecturer on Chemistry, Cheltenham College.

THE conversion of nitric acid into ammonia by the well-known method of boiling with zinc, iron, and potash, practised by Mr. Harcourt, suggested the idea of such conversion being possible with the hydrogen furnished by means of electrolysis. An experiment of the following nature proved the possibility in a qualitative sense:—Into a small porous earthern cylinder, 1 inch in diameter and 1½ inches high, was placed a little dilute nitric acid the negative pole of a three-cell arrangement of Bunsen's battery was introduced, and the vessel placed in a small beaker, containing dilute nitric acid and the positive pole of the battery.

The liquid was withdrawn from the cylinder in about half-an-hour, and the usual test of boiling with excess of potash was tried, when the ammonia was easily detected by the odour and its action upon test-paper.

Nitrate of potassium was substituted for the dilute nitric acid in the porous vessel: ammonia was easily detected in this case also. Nitrate of potassium solution was acidulated with hydrochloric acid, and submitted to voltaic action for an hour. The solution was mixed with bichloride of platinum, and evaporated to dryness, when a fair amount of the double chloride of platinum and ammonium was obtained. This precipitate was examined, and found to be entirely pure.

The question then suggested was, whether any quantitative result could be obtained. For this purpose, the porous cylinder used in the previous experiments was cemented to a glass tube, of the same diameter and 6 inches long, in order that any splashings caused by the escaping bubbles of gas should not cause an error. The compound tube was placed in a beaker, high enough to take the porous vessel, and just large enough to admit the positive pole. The tube and beaker were placed in a moderately large vessel of cold water, to keep down the temperature, which, in a previous experiment, had softened the cementing material joining the tube and porous vessel. The arrangement is represented in the figure. A weighed amount of pure nitrate of sodium was placed in the porous vessel, and submitted to electrolysis, the ammonia being estimated as the double chloride of platinum and ammonium.



From a considerable series of experiments, the amount of double chloride yielded was found to be below the calculated result. Several modifications were then tried; such as dropping the solution of the nitrate very slowly upon the negative pole, elevation of the temperature both of the solution and of the battery; reduction of the resistance offered to the voltaic battery. It is to be regretted, however, that, in spite of a fairly extensive series of experiments with these various modifications, I have only succeeded in converting half the nitrate into ammonia. It has been also proved that no loss of liquid takes place through the porous vessel.

I have been induced to make known these results with the hope of obtaining some suggestion which may solve the difficulty of the non-conversion of the other half of the nitrate.

ON THE

ACTION OF HYDROCHLORIC ACID ON MORPHIA.*

By AUGUSTUS MATTHIESSEN, F.R.S.,
Lecturer on Chemistry in St. Bartholomew's Hospital,
and C. R. A. WRIGHT, B.Sc.

WHEN morphia is sealed up with a large excess of hydrochloric acid, and heated to 140°—150° for two or three hours, on opening the tubes after cooling no gas is found to have been formed, nor is there any formation of chloride of methyl. The residue in the tube contains the hydrochlorate of a new base, differing considerably in its properties from morphia. It may be obtained in a state of purity by dissolving the contents of the tube in water,

* Abstract of a paper read before the Royal Society, June 10th, 1869.

adding excess of bicarbonate of sodium, and extracting the precipitate with ether or chloroform, in both of which the new base is readily soluble, whilst morphia is almost insoluble in both menstrua. On shaking up the ethereal or chloroform solution with a very small quantity of strong hydrochloric acid, the sides of the vessel become covered with crystals of the hydrochlorate of the new base. These may be drained from the mother liquors, washed with a little cold water, in which the salt is sparingly soluble, and re-crystallised from hot water and dried on bibulous paper or over sulphuric acid.

This hydrochlorate contains no water of crystallisation. After drying in the water-bath, it yielded results on combustion with chromate of lead and oxygen agreeing with the formula $C_{17}H_{17}NO_2HCl$.

From a solution of the hydrochlorate in water, bicarbonate of sodium precipitates a snow-white non-crystalline mass, which speedily turns green on the surface by exposure to air, and is therefore difficult to obtain dry in a state of purity. This precipitate is the base itself.

It hence appears that the new base is simply formed from morphia by the abstraction of the elements of water.

Morphia. New base.

$$C_{17}H_{19}NO_3 = H_2O + C_{17}H_{17}NO_2,$$

We propose to call the new base apomorphia, for reasons given subsequently.

When the hydrochlorate of apomorphia in a moist state is exposed to the air for some time, or if the dry salt is heated, it turns green, probably from oxidation, as the change of colour is accompanied by an increase of weight. The base itself, newly precipitated, is white, but it speedily turns green on exposure to air. The green mass is partly soluble in water, communicating to it a fine emerald colour—in alcohol yielding also a green tint, in ether giving a magnificent rose-purple, and in chloroform with a fine violet tint.

The physiological effects of apomorphia are very different from those of morphia; a very small dose produces speedy vomiting and considerable depression, but this soon passes off, leaving no after ill effects,—facts of which we have repeatedly had disagreeable proof while working with it.

Dr. Gee is now studying these effects, and has found that 1-10th of a grain of the hydrochlorate subcutaneously injected, or ½ grain taken by the mouth, produces vomiting in from four to ten minutes. Our friend Mr. Prus allowed himself to be injected with 1-10th grain, which produced vomiting in less than ten minutes. From Dr. Gee's experiments on himself and others, he concludes that the hydrochlorate is a non-irritant emetic and powerful antistimulant. As from these properties it appears probable that it may come into use in medicine, we have called it apomorphia, rather than morphinine, to avoid any possible mistakes in writing prescriptions.

CONTRIBUTIONS TO ANALYTICAL CHEMISTRY.*

By DR. E. FLEISCHER, of Dresden.

Estimation of Baryta, Strontia, and Lime.

The estimation of these three alkaline earths is generally effected after they are separated from each other. These separations can be dispensed with if the indirect method be employed, thereby avoiding the loss attendant upon different separations, and materially hastening and simplifying the whole estimation. The following indirect method, which has proved to be the most preferable for the estimation of these three bases, may also be employed in the presence of magnesia. In the first place, the lime, strontia, and baryta, must be precipitated as carbonates, by means of carbonate of, and caustic, ammonia. The following is worthy of remark:—It is well known that, in a liquid containing much sal-ammoniac or nitrate of ammonia, neither lime, strontia, nor baryta will be completely precipitated by carbonate of ammonia; so that, after filtering, it is possible, by means of sulphuric acid or oxalate of ammonia, to recognise a more or less considerable quantity. The cause of this phenomenon is, that ammoniacal salts of strong acids have a solvent action upon carbonate of lime, which effect is still stronger upon carbonates of strontia and baryta. Should, on the other hand, acetate or carbonate of ammonia be used, instead of sal-ammoniac or nitrate of ammonia in solution, the precipitation of the three bases by carbonate of ammonia will be so complete that it will be impossible to discover in the filtrate, by means of the before-mentioned reagents, any traces of lime, strontia, or baryta.

In order to have in solution no other ammoniacal salts than acetate and carbonate of ammonia, it will suffice to add to the tolerably neutral solution as much acetate of soda as there is supposed to be sal-ammoniac or nitrate of ammonia held in solution, and then to supersaturate with ammonia and carbonate of ammonia, and, after a short digestion, to cool the solution: the carbonated alkaline earths which have in this manner been completely precipitated are now filtered off.

Digestion is not absolutely necessary here; it only serves to render deposits granular, which would otherwise be voluminous. On the other hand, in order to obtain complete precipitation, it will be necessary to reduce the whole to the ordinary temperature before filtering, because hot acetate of ammonia has a solvent action upon carbonated alkaline earths, although in a far less degree than sal-ammoniac.

A certain degree of dilution of the ammoniacal salt is to be recommended; in any case, the solution must not be more concentrated than in the proportion of one salt to twenty water. According to rule, I manage so as to dilute the digested mass with its own volume of distilled water, allowing it to cool still further before filtration.

The carbonate of soda may be substituted for the acetate, in order to decompose the sal-ammoniac; but if, at the same time, magnesia be held in solution, the presence of much salts of ammonia, with stronger acids than carbonates, will be necessary, in order that it may not be deposited with the alkaline earths. For this purpose, the addition of acetate of soda is eminently suitable; because the acetate of ammonia thus formed (as with oxygenated salts of ammonia generally) prevents the precipitation of the magnesia much more than sal-ammoniac does, without, as before remarked, dissolving baryta, strontia, or lime.

In the presence of magnesia, a too great excess of carbonate of ammonia must be avoided as a reagent, in order to hinder the formation of ammoniacal carbonate of magnesia, which is difficult to dissolve. After these precautionary measures, the baryta, strontia, and lime having been separated (also from magnesia, if such be present), the deposit is washed, filtered, dried, heated, and weighed; it is then dissolved in a measured quantity of normal muriatic acid and estimated. This is done, after removing the carbonic acid by digestion, from the diluted solution (which is coloured with litmus), by estimating with one-half normal ammonia the amount of muriatic acid which had been required to transform the three carbonated salts into chlorides. The solution is now mixed with bichromate of potash and caustic ammonia in excess, to precipitate all baryta, so that no trace of it may be detected in the acidulated filtrate, by fluo-silicate of potash and spirit of wine.* The chromate of baryta is filtered off, and washed until sugar of lead ceases to give a yellow precipitate in the solution which runs through; to this chromic acid is now added, according to the known pro-

* Communicated by the Author.

* Pure chloride of barium solution, also, produces no turbidity when, after the precipitation of baryta by chromate of potash and ammonia, the filtrate is mixed with sulphuric acid. It is, of course, understood that the reagents employed in precipitation are quite free from sulphuric acid.

cess, together with a measured quantity of a standard solution of green vitriol; and the amount of baryta is then obtained, according to the formula—

$$CrO_3 \times 1{,}527 = BaO,$$
$$\text{or } CrO_3 \times 1{,}964 = BaOCO_2.$$

If, on the one hand, the amount of carbonate of baryta thus obtained be deducted from the weight of the three carbonates, and, on the other, the amount of muriatic acid answering to the baryta be calculated, the difference between this amount of HCl and the amount found will be the quantity of muriatic acid which corresponds to the united weight of CaO,CO_2 and SrO,CO_2, which has just been calculated. The amount of carbonate of lime and carbonate of strontia is obtained as follows:—

Calculate the amount of carbonate of lime which is equivalent to the known quantity of HCl contained in the excess of $CaOCO_2$, and $SrOCO_2$; deduct this from the weight of the two carbonated salts, and multiply the remainder by the constant factor $3_{11}^{1}{}_{8}$ and the product will then be the required quantity of $SrOCO_2$; this, when again subtracted from the united weight of both salts, yields, as its remainder, the quantity of carbonate of lime. The constant factor, $3_{11}^{1}{}_{8}$, may be obtained by the following calculation:—

	$CaOCO_2 =$	50
	$SrOCO_2 =$	74
	$CaOCO_2 + SrOCO_2 =$	124
hence	$2CaOCO_2 =$	100

and the remainder, 24, in the equivalent of $SrOCO_2$, equal to 74, yields, when divided, $S = \frac{74}{24} = 3_{11}^{1}{}_{8}$.

This method of estimating these three alkaline earths always yielded very satisfactory results. One advantage is that it is quickly carried out and also very exact, because the precipitations will be all perfect, and the two volumetric estimations involved in the method admit of great exactitude. Moreover, the troublesome and somewhat uncertain separation of the strontia and lime with a concentrated solution of sulphate of ammonia is avoided, and which is very inconvenient in estimating the lime. In the absence of strontia, I either precipitate the lime and baryta as carbonates,* estimating the precipitate alkalimetrically; or I precipitate the baryta as sulphate, the lime as carbonate, by digesting the solutions of both with a mixture of three parts of sulphate of potash and one part of carbonate of potash; weigh the dried and ignited precipitate, and estimate the carbonate of lime alkalimetrically.

A CHEMIST'S VIEW OF THE SEWAGE QUESTION.†

By EDWARD C. C. STANFORD, F.C.S.

(Continued from p. 270.)

No. II.

ABOUT twelve months ago, I read a paper on this subject before the Sewage Association of Glasgow; since then, the members of that association, with all their varieties of opinion, have passed one unanimous resolution—that, whatever system be adopted, the excreta must be kept out of the public sewers, the expression of a conviction which will be that of any patient enquirer into this difficult question.

In the paper referred to, I endeavoured to show that, whatever may be the best, the present water-closet system, with all its boasted advantages, is the worst that can be generally adopted; briefly, because it is a most extravagant method of converting a mole-hill into a mountain. It merely removes the bulk of our excreta from our cities, to choke our rivers with foul deposit, and rot at our neighbours' doors. It increases the death-rate, as well as all other rates, and introduces into our houses a most deadly enemy, in the shape of the sewer gases.

Since then, the report of Messrs. Bateman and Bazalgette has appeared, and it proposes (what every one knowing the views of the authors would at once have predicted) to put down miles of costly sewers to carry the excreta to the Ayrshire coast, where, perhaps, the inhabitants may oblige us to take it back again; in other words, to commit the error of London, and wake up in a few years to the same bitter repentance.

We cannot be surprised at this; we cannot expect homœopathic treatment from an allopathic physician, especially if, as in this case, "bleeding" is to be again the universal cure. The engineer's treatment of town excreta always reminds me of the country doctor in America, who put all his feverish patients through a course of convulsions, because, though he didn't understand *fevers*, he *could* cure *fits*. In our numerous discussions, I have always maintained that chemists have been most unfairly treated in this matter. The public like to see what they pay for; they can see bricks and mortar, and therefore have allowed engineers to give them an intimate pocket-purse knowledge of this expensive commodity, for which they have paid in more than one sense—through the nose. Engineers have too fondly believed that water is the great purifier, and so they dilute the excreta with 365 times its bulk of water, and reduce its value to 1d. per ton, and then turn round on the chemist and expect him to reverse the process, pick out the penny, and repay the expenditure. Now, if it were a simple mixture—if it were only to separate the grain of wheat from the sack of chaff—the problem would be difficult enough; but we know the case to be far worse than this—it is the handful of yeast in the sack of flour that we are called upon to extract, and the fermentation of which we are expected to prevent, *after* it has occurred. A small portion of dilute sewage, mixed with a large excess of water, soon renders it all equally offensive, and the problem of extracting its value is one which no chemist need ever attempt to solve.

The water-closet, with many apparent advantages, and with all our prejudices in its favour, carries an attendant train of evils, which I am fully persuaded will ultimately doom it to oblivion.

As, therefore, engineers have not put the subject fairly before chemists, I propose to take a noble revenge, and put the subject fairly before engineers. I ask them why they consider water to be the only vehicle for removing excreta?—why not earth?—why not air? Have they ever fairly investigated or thoroughly experimented on the other methods? Have they not rather confined their studies to *fits*, and forgotten *fevers*?

So many attempts have been made by chemists to pick up the halfpence that engineers have so plentifully flung into the mud, that I cannot even notice them, except to remark that, in the opinion of all the scientific chemists who have specially investigated these attempts, they have all signally failed.

I must allude, however, to the process of Mr. Chapman, as one of the latest methods of dealing with town sewage; this is a process of distillation, after treatment with lime and thorough putrefaction. He, however, confesses his difficulty, by wishing to reduce the sewage of this city from 31,000,000 gallons to 1,000,000 gallons daily. This, of course, requires a complete alteration in the existing system, and it still dilutes the excreta with more than ten times its bulk of water. The lime process, and the putrefaction required to decompose the urea, would be extremely offensive, and require vast storing tanks. In working 1,000,000 gallons daily (it would more probably amount to 2,000,000 gallons); he would have to treat 4464 tons daily, the total chemical (not the extractible) value of which is 2s. 6d. per ton; and he expects to do this with 20 tons of coal. He proposes to adopt an ingenious arrangement of eight boilers, steaming exhaus-

* Especially when mangnesia is present.

† Read before the Chemical Section of the Glasgow Philosophical Society, April 19th, 1869.

tively, to distil off the ammonia, heating up the feed sewage, after precipitation by lime, by the hot water discharged from the boilers by a kind of brew-house refrigerator with its object reversed. He expects to distil off 1-12th; but I think it must be at least 1-10th, or 100,000 gallons, evaporated by 20 tons of coal = 5,000 gallons to 1 ton. The report of Professors Lyon Playfair and Johnstone puts the average evaporation for Scotch coal at 7·7 tons, or 1712 gallons per ton, and at this rate 58 tons would be required for the mere evaporation. Then, for raising the heat, the same report says that 1 ton of Scotch coal raises 56 tons of water from 32° to 212° F., or, say, 50 tons of water from 52° to 212° F., requiring, therefore, 96 tons for heating up, making a total of 148 tons a day. Mr. Chapman, therefore, expects to save, by heating feed water, and by exhaustive steaming, a total of 128 tons of coal daily, or 600 per cent. Can this be done? If it can, then whatever may be the result of his process, as applied to sewage, it will make him the greatest and most daring authority on that equally important subject, the economy of fuel. He puts down no loss for radiation. This should, I think, be at least 10 per cent, which would require nearly as much as his total calculated expenditure for fuel. In using eight boilers, of 4,000 gallons each, he expects to get off all the ammonia in half an hour's steaming. Now, we all know that the estimation of free ammonia in the laboratory is one of the most tedious processes, requiring a long-continued ebullition, and the experience of distillers, on the large scale, amply corroborates this, and proves that it does not pay to distil liquors containing under 1 per cent of ammonia (some manufacturers double this estimate). The total amount in the sewage to be distilled would be under 0·2 per cent; I think, therefore, that the process of Mr. Glassford, of evaporation with sulphuric acid (for which I must refer you to his pamphlet on London sewage), is better than this; fuel is the great question in both, but in his the results are certain, in Mr. Chapman's they are problematical.

Both are, however, connected with the water system, which I believe to be a mistake, and I think we must ultimately come, either to a system like Capt. Liernur's, by what may be called pneumatic despatch, or to the dry-closet system. Of the former I have fully treated in a former paper, and wish now to speak more particularly of the latter. During the past year, Moule's dry-closet has been largely introduced; all who have used it speak in the highest terms of its efficiency, and there are already strong indications of its becoming the system of the future. It is the only system that has succeeded during the hot fortnight at the Wimbledon meeting; and it is particularly adapted to hot climates, where the evils of the water-closet are most conspicuous. The objections urged against the system, when earth is used, are—1st, the large quantity of earth required—three and a half times the weight of the excreta; and, 2nd, the difficulty of obtaining the quantity required, and of drying it. Now, both these difficulties are disposed of by using charcoal. I employ, by preference, sea-weed charcoal, because it is the most porous, the best absorbent, and the cheapest. It only requires one-fourth of the weight, compared to earth; and when the mixture is removed and placed under cover, it soon dries. This mixture can be stored for any length of time, and used again several times. When convenient, it is re-burned, like the char in sugar refineries, except that this process is carried out in apparatus which admits of collecting the ammonia and other products condensed. The whole of the ammonia is thus collected; whilst the phosphoric acid, potash, and mineral matters accumulate in the charcoal, together with the carbon from the organic constituents of the excreta. The weight of the charcoal is increased to the extent of about 5 per cent with each using, and, if dried and re-used five times, about 25 per cent with each re-burning. With this constant addition, the char does not require replacing with fresh material, so that its cost is only a primary outlay—the ultimate result being that the excreta is deodorised by a charcoal derived from itself, and a company working this process would, in addition to securing the whole of the ammonia, become sellers of a charcoal second only in value to that from bones to the extent of, in Glasgow, if the process were general, 19 tons a day, or 6,935 tons a year; the total quantity of excreta which Glasgow has to remove being 385 tons a day, and its value, at 29s. 6d. per ton, = £569.* The ultimate result being the same, any charcoal may be used at first. The process is carried out without odour, from the closets to the finished products. Of course the process may be modified; for instance, suppose the char to be used five times, and only dried, the addition to its value would be as follows (I take equal parts, as this charcoal will absorb at least an equal weight of even urine):—

1 ton seaweed char, at £2 } = 30 cwts. manure at £9 7s. 6d.
5 tons excreta, at 29s. 6d. } = £6 5s. per ton.

Or, if re-burnt, it would yield 25 cwts. of charcoal, and the whole of the nitrogen would pass over in the distillation, as ammonia. Dr. Wallace estimates the cost of re-burning char in sugar refineries at 3s. 6d. per ton for labour and fuel, containing 31 per cent moisture, which would be much over that referred to. Here, then, we have a simple process for recovering the whole of the value from excreta, of general application, and the results of which can be predicted by chemists with absolute certainty, as far as those products to which we at present attach value are concerned; but the uncertain portion is, as usual, the most interesting, for in the destructive distillation of excreta we are exploring a new field, which promises great interest.

I regret that I am obliged to bring this paper forward before the new products have been studied. The distillation generally is remarkably similar in its products to that of bones, and also to that, which most resembles it, of sea-weed. Besides ammonia, acetic acid, with a little butyric acid, acetone, and pyrrol are the most marked bodies. I cannot speak more definitely of these products in this paper, as they are still under investigation. The following analysis of urine is taken from Miller, representing the average composition in 1,000 grs., sp. gr. 1·020. The calculated percentage of nitrogen is appended:—

			Nitrogen.	In 100 parts of solid matter.	Nitrogen.
Solid Matter, 43·20.		Water	956·80		
	Organic, 29·97.	Urea	14·23	6·64	33·00	15·40
		Uric acid	0·37	0·12	0·86	0·27
				6·76		15·67 = 9 NH_3, 19. Sulphate of ammonia, 75·72.
		Alcoholic extract	12·53		29·03	
		Watery extract	2·50		5·80	
		Vesical mucus	0·16		0·37	
	Inorganic, 13·35.	Chloride of sodium	7·22		16·73	
		Phosphoric acid	2·12		4·91	
		Sulphuric acid	1·70		3·94	
		Lime	0·21		0·49	
		Magnesia	0·12		0·28	
		Potash	1·93		4·47	
		Soda	0·05		0·12	
			999·94		100·00	

= 1·36 NH_3, 8·2. Sulphate of ammonia, 31·86, or 3·18 per cent.

The average portion voided by each individual may be taken at 40 ozs., and of fæces, 4 ozs., total 44 oz. daily; or, 1·7 ozs., solid, from urine, and 1 oz., solid, from fæces = total of 2·7 ozs. solid excreta daily. The following analysis of the fæces is from Berzelius:—

Water		75·3	
Bile	0·9	5·7	Solid matter, 24·7.
Albumen	0·9		
Extractive matter	2·7		
Salts	1·2		
Insoluble residues of digested food		7·0	
Insoluble matters added in intestinal canal—mucus, biliary resin, and peculiar animal fat		12·0	
		100·00	

Containing, according to Playfair—
15 p.c. nitrogen, and 45 p.c. carbon, and about 25 p.c. ash.
= nitrogen 3·75 p.c.
= 4·55 NH_3.
= 17·65 p.c. sulphate of ammonia.
= 70·71 in dry solid matter.

* Value given in my former paper.

The ash contains, according to Porter:—

	Ash of Fæces.	Ash of Urine (calculated).
Chloride of sodium	1·33	54·15
Phosphoric acid	36·03	15·89
Sulphuric acid	3·13	12·73
Lime	26·46	1·57
Magnesia	10·54	0·89
Potash	6·10	14·45
Soda	5·07	0·38
Peroxide of iron	2·50	—
Carbonic acid	5·07	—

Assuming, then, the proportions voided to be in the proportion of 17 dry, from urine, to 10 dry, from fæces, the resulting chars may be expected to have the following composition:—

	Urine.	Fæces.	Mixed Excreta.
Percentage of char in dry solid matter	50	70	57
Ammonia = sulphate	73·72	70·71	72·60

COMPOSITION OF CHARS.

	Per cent.	Per cent.	Per cent.
Carbon	33·33	45·00	37·65
Chloride of sodium	36·10	0·33	9·51
Phosphoric acid	10·60	9·01	10·01
Sulphuric acid	8·49	0·78	5·63
Lime	1·05	6·61	3·11
Magnesia	0·60	2·63	1·35
Potash	9·64	1·52	6·63
Soda	0·26	1·26	0·63
Peroxide of iron	—	0·62	0·23
Carbonic acid	—	1·26	0·46

The nitrogen in the mixed excreta, in the proportions voided, is equal to 4·49 per cent of sulphate of ammonia.

In the char from urine, the phosphoric acid is principally combined with potash, and therefore soluble. This char alone would be a valuable manure as containing a large proportion of soluble phosphates; but the result of commencing with seaweed charcoal, which is rich in carbonate of lime, will be to form phosphate of lime at the expense of the carbonate—in other words, to form, by treatment with urine, re-burning, and washing, the animal charcoal required by the sugar refiner. This expected result is verified in the following tables of analyses. I regard the phosphate of lime thus gradually formed, from its minute state of division, to be quite equal, in agricultural value, to ordinary soluble phosphate. The washed residual char from fæces is at once available for the refiner, as it contains about 26 per cent of phosphates of lime and magnesia, with but a small proportion of carbonate. I know no reason why the product of disintegrated bone and muscle should not be used for this purpose as well as the bones themselves.

In distilling 100 tons of the dry product from mixed excreta, therefore, we should obtain 72 tons of sulphate of ammonia, and 57 tons of a charcoal containing 10 per cent of phosphoric acid in its most available form for manure, and 6 per cent of potash. It will be seen, from Berzelius's analysis, that nearly 50 per cent of the fæces consist of fatty matter—how will this appear in the distillation? In a population of 500,000, this item amounts to nearly 7 tons a day!

I expected a loss of ammonia in drying, but it is very small, and appears to arise from the free lime in the char, as it will be seen further on that the loss decreases in using the char with urine. In a small experiment with urine, I found the total loss, in drying by artificial heat with new char, to be 2·06 per cent of the ammonia, or 0·105 per cent of the urine employed.

I append analysis of 1 lb. of char which was re-burnt fifteen times with an equal weight of urine; a portion of the char was lost, which prevents my giving the increase in weight; I believe, however, the addition of carbon would be too slight to effect an increase in the total, with so many re-burnings. The percentage is decreased:—

	Char used.	After re-burning.	Increase per cent.
Water	10·0	2·80	—
Soluble salts	0·6	11·15	10·55
Insoluble	89·4	86·05	—
Soluble.			
*Chloride of sodium	—	8·75	8·75
Sulphuric acid	0·3	0·34	0·04
Phosphoric acid	—	2·00	2·00
Potash	0·3	2·40	2·10
Insoluble.			
Carbon	54·4	29·40	—
Silica, &c.	9·1	13·10	4·00
Phosphate of lime	4·8	20·05	15·25
Carbonate of lime	17·4	19·75	2·35
Carbonate of magnesia	3·4	3·40	—

The urine used appears to have been deficient in sulphates and high in phosphates, these two ingredients being subject to considerable relative variation. The distillates gave 192 ozs. liquid, containing free ammonia equal to 3,047 grs. sulphate, or 2·9 per cent of the urine, showing a slight loss, inseparable from destructive distillations on the small scale. The charcoal should be used at least five times before re-burning, and for urine alone it may be employed ten times. I append a table, showing the analytical results of this process with urine:—

* In this and the following analyses, the whole of the chlorine has been calculated, for convenience, as chloride of sodium, which, in some cases, is therefore too high.

	Increase, per cent.				Increase, per 1,000 grs. of Urine.			
	1.	2.	3.	4.	1.	2.	3.	4.
Dry solid matter	33·30	62·50	210·00	347·94	33·30	31·25	42·00	34·79
Char	7·50	12·90	80·40	151·96	7·50	6·45	16·40	15·19
Ammonia sulphate	21·70	36·80	51·12	105·64	29·00	29·90	31·60	47·31

RESIDUAL CHARS.

	Ordinary Char.	Composition, per cent. 1.	2.	3.	4.	Increase, per cent. 1.	2.	3.	4.	Increase, per 1,000 grs. of Urine. 1.	2.	3.	4.
Water	10·00	1·60	3·00	—	—	—	—	—	—	—	—	—	—
Soluble salts	0·60	15·80	19·80	39·40	52·20	15·20	19·20	38·80	51·60	20·40	15·70	24·30	22·78
Insoluble	89·40	82·60	77·20	60·60	47·80	—	—	—	*41·60	2·04	23·90	19·60	12·47
Soluble.													
Chloride of sodium	—	5·40	13·10	28·02	24·70	5·40	13·10	28·02	24·70	7·18	10·60	17·30	11·06
Sulphuric acid	0·30	2·05	3·29	3·77	3·77	1·75	2·99	3·47	3·47	2·33	2·64	2·21	1·62
Phosphoric acid	—	2·20	0·40	trace	1·60	2·20	0·40	—	1·60	2·92	0·32	—	0·71
Potash	0·30	2·80	4·99	7·00	10·38	2·50	4·69	6·70	10·08	3·32	3·89	4·10	4·62
Insoluble.													
Carbon	54·40	37·40	40·00	35·40	28·20	—	—	—	*26·20	*4·50	5·30	11·06	7·19
Silica, &c.	9·10	13·60	10·00	8·00	4·40	4·50	0·90	—	*4·60	8·98	3·57	3·14	1·06
Phosphate of lime	4·80	8·00	9·60	11·40	10·20	3·20	4·80	6·60	5·40	5·84	5·40	6·10	4·08
Carbonate of lime	17·40	20·40	13·20	4·20	1·15	—	—	—	*16·25	9·73	2·00	*0·88	*1·22
Carbonate of magnesia	3·10	5·40	3·16	1·93	1·20	2·30	0·06	—	*1·90	4·08	0·98	0·57	0·23

* Decrease.

WASHED CHARS.

	Ordinary Char.	Composition, per cent. 1.	2.	3.	4.	Increase, per cent. 1.	2.	3.	4.
Carbon	54·40	45·30	51·80	58·40	59·00	*9·10	*2·60	4·00	4·60
Phosphate of lime	4·80	9·60	12·40	18·80	21·34	4·80	7·60	14·80	16·54
Carbonate of lime	17·40	24·60	17·10	6·90	2·40	7·20	*0·30	*10·50	*15·00
Carbonate of magnesia	3·10	6·50	4·10	3·10	2·51	3·40	1·00	—	*0·59

* Decrease.

No. 1 is from charcoal dried up with ten times its weight of urine before re-burning; No. 2 has been treated with twenty times its weight, No. 3 with fifty times its weight, and No. 4 with 100 times its weight of urine before re-burning. It will be seen, that in No. 4 more than the theoretical amount of ammonia is obtained; that from Nos. 1, 2, and 3 are obtained by simple destructive distillation. No. 4 only yields ammonia equal to 50·48 per cent of sulphate when heated in this way, the quantity given, 105·64 per cent, being that obtained with soda-lime; the residual nitrogen is not left in the char, but goes off in the distillation in some other form than ammonia. I shall recur to this subject in a subsequent paper. The retention of nitrogen after drying is, however, extraordinary, when the product yields ammonia equal to 105 per cent of sulphate. No Peruvian guano can be compared to this in fertilising value.

The washed chars acquire the composition which fit them eminently for the sugar refiner.

The experiments with closet excreta are unfinished, and it is difficult, in working on small quantities, to obtain uniform results. We find one of Smith's dry-closets use ½ lb. of seaweed char per charge, the charge of dry earth being 2 lbs. Moule's closet uses rather less. There were seven uses in our first experiment, the contents of the pail being re-burnt at once, without drying.

Weight before distillation .. .. 130 ozs.
Residual char weighed .. .. .. 48 ,,
Weight of excreta 82 ozs.=11·7 ,, per use.

The distillation gave 66 ozs. of gas liquor containing free ammonia=2·8 ozs. sulphate=3·4 per cent of mixed excreta; this represents only the free ammonia, or that existing as carbonate, a portion is combined with acetic acid, which was not estimated.

The same method is equally well adapted for treating pot ale from distilleries, and blood and offal from slaughter-houses. The former is an important subject in Glasgow, and I can, in this paper, only shortly allude to it. According to Dr. Wallace, one of the distilleries in Glasgow sends into the sewers 83,000 gallons of this pot ale, containing nitrogen equal to 118 grs. of ammonia per gallon; so that the daily discharge of this one distillery is equal to the total excreta of 48,970 persons, or one-tenth the population of Glasgow.

The process can be adapted with ease to urinals as well as closets. I am enabled to exhibit some mixtures of charcoal and night soil made twelve months ago. I was curious to know if these mixtures had gone further in the oxidation of the ammonia, and formed some nitrates, but not a trace can be detected.

I submit that the dry-closet system, with this process, has the following great avdantages:—

1. Total freedom from all odour. All must have noticed sometimes the sickly odour of a water-closet, arising, not from the excreta, but from the gas from the sewers.

2. Certain prevention of all contamination and spread of infectious diseases arising from sewer leakage into our wells or sewer gas into our houses.

3. Saving of water, equal, in Glasgow, to £40,000 a year, if the water-closet system were general.

4. Saving of expense in repairs and removal. 1 cwt. of charcoal per month is sufficient for each closet when used by six persons daily, and the whole may be allowed to fall at once from the closet, through a 12-inch pipe, to a cesspit below the house. A cess*pool* is a serious evil, but I know of no evil to a cess*pit*.

5. By this process alone can the whole of the valuable material be recovered for our lands.

Dr. Fergus has shown some remarkable examples in which gastric fever has been traced to the escape of sewer gas through small openings eaten through the top of the soil-pipe. This appears to be a wide-spread evil. I have examined some of these specimens, and find the substance to be a sort of lead plaster, containing, also, lime and some fatty acid, which requires further examination. I have shown that only remedial measures can be adopted, where the water-closet system has been carried out, by placing boxes of charcoal in the closets, and filtering the sewage through charcoal before allowing it to enter rivers.

Our authorities want, of course, some grand scheme; but they forget that the question is one of minute details. We are assailed by a large army of small nuisances—one, at least, to every house, and we must attack them one at a time. Attacked in their united strength, they will assuredly overcome us. Ought we not rather to strike at the root of the evil? Ought we not to stop the mischief at its numerous sources, and before these can combine into a mighty force, which carries everything before it?

Let the subject be calmly and carefully discussed; let us not be carried away by great schemes and useless expenditure; let us not leave to posterity heavy taxes, with barren wastes and desolate cities, but let us rather pay our own way, and leave our country fertile and our towns pure, and I shall never regret that, however imperfectly this subject has been brought before you, my earnest wish has been to strike "one more blow for life."

A lively discussion followed the reading of the paper, the general opinion of the members of the section being highly favourable to the process, which was considered the most novel and practical which has yet been introduced.

NOTICES OF BOOKS.

Proceedings of the American Association for the Advancement of Science; Sixteenth meeting, held at Burlington, Vermont. Cambridge, U.S.: J. Lovering. 1868.

IT will be new to some of our readers to hear that there exists an American Association for the Advancement of Science, corresponding to our British Association, and that the meeting which is chronicled in the work we are about to discuss is the sixteenth meeting of that association. The institution and support of such an association indicates a zeal for science among our American brethren which is surely a good omen, and a healthy sign of the times. Nothing more conduces to the spread of a love for science, and to the diffusion of scientific knowledge, a tutored scientific taste, and a *modus* of scientific thought, and nothing more encourages original research, than the banding together of scientific men for the one purpose of furthering each his individual study and pursuit. And what greater proof of this can be needed than that which Europe furnished in the seventeenth century? The downfall of Aristotelianism, and the consequent spreading love for the "new philosophy," did not culminate in, but almost started with, the rise of numerous scientific societies—the Accademia del Cimento, the Royal Society, the Collegium

Curiosum, and the Académie des Sciences, all appeared in less than half a century after the death of Bacon and Galileo. A period of great intellectual activity exists not without the blossoming and blooming of such institutions, and they react upon the period, and induce in it a greater charge of intellectual vigour. In a country like America, mighty in great works, the effect of such an association, if well supported, ought to be immense. We say "mighty in great works," because the opening of the Pacific Railway is yet in our minds, and, if there had not been some hundreds of eighth wonders of the world since the hanging gardens of Babylon were, with her "Babylon magna, mater fornicationum et abominationum terræ," razed to the ground, and since the Rhodian Colossus was broken up and sold as old brass, we think the Pacific Railway would be that eighth wonder. Perhaps the only work to be compared with it for extent and magnitude is that other among the ancient (and modern) wonders of the world, the Great Wall of China; let us, however, remember that the Suez Canal and the Mont Cenis Tunnel are approaching completion, and will soon have to be placed in the same category with the Pacific Railway. But we are plunging into a theme which, if extended, will bear us far from our present subject.

The subjects which engage the attention of the American Association for the Advancement of Science are thus divided:—A. (1) Mathematics and Astronomy; (2) Acoustics; (3) Physics and Chemistry; (4) Physics of the Globe (or, as we usually say in this country, Meteorology). B. (1) Geology and Mineralogy; (2) Palæontology; (3) Zoology.

The Association possesses a President, Vice-Presidents, Standing Committees, and Local Committees; and it appoints special committees for the discussion of special subjects. Among the latter we notice "a Committee to report in relation to uniform standards in weights, measures, and coinage." The address of the President (Professor J. S. Newberry), although short, gives a fair *resumé* of the dominant subjects of the day, in regard to both the philosophy of matter and the philosophy of mind.

The first paper which calls for our notice is by C. S. Lyman, of New Haven (Conn.), "*On a New Form of Wave Apparatus.*" It is designed to illustrate waves whose "type is the ordinary ocean wave in deep water. The apparatus exhibits not only the wave profile, with its progressive motions, but also the motions taking place below the surface in the whole mass of liquid effected;" and it illustrates the wave theory established by Gerstner, Scott Russell, Rankine, and others. The apparatus could scarcely be described without the aid of a woodcut, but it somewhat resembles the wave apparatus invented some years ago, by Wheatstone (?) We frequently wish that some apparatus of this description appeared upon the lecture table, specially in lectures on light and sound. The subject of plane polarised light is difficult enough, in all conscience; what, then, shall we say to circular and elliptic polarisation? Surely, some means of visualising these actions might, with advantage, replace the black-board, and the old story of the wire grating and the card, and the ray of light with its *two sides*, an expression nearly as appropriate, we always think, as that about the two sides of a round plum-pudding.

In a paper entitled "*Tellurium a Metal*," Mr. L. Bradley adduces experiments and facts which compel him to regard tellurium as a metal. "It is true," he says, in conclusion, "that tellurium is not malleable, nor ductile, as are many of the metals; neither is bismuth nor antimony. Like the non-metallic substances, it unites with oxygen to form acid; so do antimony, arsenicum, gold, chromium, manganese, and many other metals. With hydrogen it unites to form a hydruret; so do potassium, arsenicum, and antimony. In short, it possesses the universally-admitted distinguishing characteristics of metals, and nothing either in physical character or chemical behaviour which it does not hold in common with some other metals. I must, therefore, call it a metal."

We come now to a paper entitled "*Chemical Diagrams and Derivative Symbols, Illustrating the Prominent Characteristics of Chemical Elements.*" Here we are introduced to a species of diagram appertaining more to heraldry than to chemistry, albeit, there is a touch of alchemical mysticism introduced. They are, for the most part, a sort of half-bred between John Rudolf Glauber's three enigmatical designs and the illustrations to the article "Heraldry" in Chambers's old "Encyclopædia." What have we here? A black triangle; along the sides of which the words carbon, boron, and silicon appear, the whole surrounded by a shield. Here, again, is a shield, "simple," bearing a triangle, "proper," on a field, "argent." In the next diagram, the triangle has burst out eruptively, and is vomiting forth small jets of bromine, sulphur, tellurium, &c. The mysticism is obviously on the increase; is this a treatise *De Secretis* of the Middle Ages? At least, we recommend the author to peruse the "Pretiosa Margarita Novella." But what is this shield with a bar sinister? Have we illegitimate compounds in chemistry? If so, we rather imagine that pseudomorphs ought to be ranged under this head. A greater wonder yet remains: the author proposes to designate lithium, sodium, potassium, rubidium, and cæsium by a star with five points. He is, perhaps, unaware that the precise star which he has drawn is used in heraldry to designate a third son. Now, to say that a third son in heraldry, and five alkaline elements in chemistry, are symbolically the same, is palpably absurd. *Q. E. D.* And we are bound to confess that we must apply the same mode of argument to the whole of the paper. We would beg to suggest to the author the term "Heraldic Chemistry."

This paper is followed by another by the same author, on "*A New Chemical Nomenclature*;" and here his mystical longings crop up again with renewed vigour. The terms of the nomenclature are mystical, heathenish, barbarous—shall we add insensate? Without a doubt, they are closely related to the words wherewith, in former ages, many have tried and some have hoped to raise the devil. What shall we say to *kalamalt*, *nobamet*, *tanamet?* The "acid chromate of sesquioxide of chromium" rejoices in the name of *chreamyut*. The bromide of ammonium is *olanab*; sulphate of soda *natemasot* [happily, poor Glauber is dead], while chloride of sodium becomes *sodamad* (and we do not wonder at it, after such treatment). One more example, and we have done. "Bihydrochlorate of bibromoterchloronaphthaline" is to be called *curulebod*, a term which must originally have been suggested by a Regius Professor of the language of the Feejee Islanders. The cardinal question yet remains. Whence comes this jargon? and what does it mean? We cannot tell, unless it is the production of that wonderful book-composing machine used by the Laputan philosophers, which took in letters and turned out completed books, in any language and on any subject; and we would venture to remind our author that hard by, was a philosopher, who proposed to build houses from the roof downwards, beginning with the chimney-pots. In all seriousness, we say to the author of this paper, seek rather to discover new chemical facts than to generalise upon those already discovered; avoid mysticism, give up heraldry and bars sinister, and, above all, remember a very pertinent passage in the "De Augmentis Scientiarum" (and does not the title-page say "The American Association for the *Advancement of Science?*"), in which Bacon says with great felicity, "*Quocirca non certæ magis experientiæ quam rectæ etiam rationi consonum videtur, utres ponatur doctrinarum intemperies. Prima est doctrina phantastica, secunda doctrina litigiosa, tertia doctrina fucata et mollis: vel sic; vanæ imaginationes, vanæ altercationes, vanæ affectationes.*"

It only remains for us to say that the work we have considered contains several admirable papers, and that we wish all success to the "American Association for the Advancement of Science."

LABORATORY NOTES.

LABORATORY PUMP.

I FORWARD a description of a slight addition which I have devised to the valuable filter pump of Professor Bunsen, whereby the filtrate, if required, may be retained for further research.

Take an ordinary bell-glass receiver used in collecting gases, open and ground at the bottom, and closed at the neck with a stopper. Remove the stopper, and replace it by a cork, through which passes the funnel and exhausting tube, as shown in the flask in Professor Bunsen's arrangement. The receiver can then be placed on a glass plate, a beaker introduced within it, and the joint between the receiver and the plate made good with a little tallow. The funnel should be lengthened by fusing a piece of glass tube to it, so that it may reach half way down the beaker, as the liquid dropping from the funnel in the rarefied medium is very apt to splash upwards.

JOHN DODS.

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CORRESPONDENCE.

MAWSON AND SWAN'S LABELS.

To the Editor of the Chemical News.

SIR,—A thorough revision of the new Book of Chemical Labels, published by Messrs. Mawson and Swan, of Newcastle, has led to the dicovery of three obvious errors of the press, which, I trust, you will permit me to point out. In the labels for Barium and Calcium Chlorides, the modern formulæ are printed as $BaNO_3$ and $CaNO_3$ respectively, instead of $Ba(NO_3)_2$ and $Ca(NO_3)_2$, and in the table of combining weights, the old number for Silicon is erroneously given as 14 instead of 28. By a singular mischance, one of the incorrect labels has been taken as a specimen for the publishers' advertisements. The indicated errors, which may be easily corrected by the pen, do not appear in the copies of the work which are now being issued. The fact that only three mistakes are discoverable in a long series of formulæ may, perhaps, be deemed satisfactory evidence of careful compilation by those who have published chemical works, but after the precautions taken to insure correctness and consistency, even these few errors suffice to disturb the equanimity of

THE EDITOR OF THE BOOK OF LABELS.

London, June 16th, 1869.

QUANTIVALENCE.

To the Editor of the Chemical News.

SIR,—The only apparent objection to the word quantivalence as a substitute for the expression atomicity is that mentioned by "C.H.," namely, that Naquet uses the latter term to indicate the maximum, and the former the varying saturating power of an element. Such limitations, however, are entirely unnecessary, and have not received general acceptance. Surely we may attack or defend the notion of constant against varying atomicity, otherwise synonymously termed quantivalence, without inventing special words or engaging in the vain endeavour to give to existing words fresh meanings in violation of etymology. Besides, if the question is to turn on priority, quantivalence was, I believe, originally offered by Hofmann as the pure equivalent of atomicity.

So much for the name; now for the subject. As a teacher of chemistry to large classes of students, I have found the doctrine of quantivalence of immense value to learners. At first, following good leaders, I treated radicals as if possessing, but not always exerting, constant quantivalence; latterly the one or two prevailing values of the (chemical) atom of the common elementary or compound radicals have been pointed out, the hypothesis of the self-contained or "latent" affinities of an atom being suppressed. This is the position I intend occupying until more evidence is forthcoming.

Reverting to the word. We recently heard one learned lecturer utter the barbarism monovalent, giving the accent to the last syllable but one; another speak of the barbarism pentavalent, also accenting the penultimate. I believe we simply follow rule in emphasising the third syllable from the end in the case of each of the words u-niv'-a-lent, biv'-a-lent, triv'-a-lent, quad-riv'-a-lent, quin-quiv'-a-lent, sex-iv'-a-lent. This matter is worthy of reference, inasmuch as, amongst other reasons, euphonious words are the most acceptable—quan-tiv'-a-lence has a better chance of employment than quan-ti-va'-lence. Taking for guidance the pronunciation accorded to the old word e-quiv'-a-lent, there need be no difficulty in this matter.—I am, &c.,

JOHN ATTFIELD, Ph.D.,
Professor of Practical Chemistry to the Pharmaceutical Society.

MISCELLANEOUS.

Memorial to Faraday.—A public meeting, at which H.R.H. the Prince of Wales will take the chair, will be held at the Royal Institution on Monday next, June 21st., at half-past 3, to consider the measures to be taken for the promotion of a memorial to Faraday.

Proposed New Physical Society.—It has been proposed to establish a Physical Society in London, and already many promises of support and proposals for membership have been received. We shall be glad to receive the views and opinions of our readers on this subject.

The British Association.—At a meeting of the council, on Saturday last, Sir Roderick Murchison in the chair, it was reported by the General Secretary that the following Presidents of sections had consented to preside at the Exeter meeting. The following Vice-Presidents were nominated:—Section A (Mathematical and Physical Science).—President, Professor Sylvester, F.R.S.; Vice-Presidents, Professor Adams, F.R.S., and Mr. W. R. Grove, Q.C., F.R.S. Section B (Chemical Science).—President, Dr. Debus, F.R.S.; Vice-Presidents, Professor Odling, F.R.S., and Professor Williamson, F.R.S. Section C (Geology).—President, Professor Harkness, F.R.S.; Vice-Presidents, Mr. R. Godwin-Austen, F.R.S., and Mr. W. Pengelly, F.R.S. Section D (Biology).—President, Professor Rolleston, F.R.S.; Vice-Presidents, Mr. C. Spence Bate and Mr. E. B. Tylor. Section E (Geography).—President, Sir Bartle Frere; Vice-Presidents, Sir George Grey, K.C.B., and Mr. A. G. Findlay, F.R.G.S. Section F (Economic Science and Statistics).—President, the Right Hon. Sir Stafford H. Northcote, M.P.; Vice-Presidents, Mr. T. D. Acland, M.P., and Colonel Sykes, M.P., F.R.S. Section G (Mechanical Science).—President, Mr. C. W. Siemens, F.R.S.; Vice-Presidents, Mr. G. P. Bidder, F.R.G.S., and Mr. C. Vignoles, F.R.S. The Mayor of Exeter, Sir Stafford Northcote, and Sir John Bowring were present, and supported the application of the working men for a special lecture during the meeting, which was unanimously agreed to, and subsequently Professor W. A. Miller, Vice-President and Treasurer of the Royal Society, was invited to undertake the duty.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we are endeavouring to effect arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 8, May 8, 1869.

We notice, in the brief report of the general meeting of the 26th of April last, under the presidency of Professor A. W. Hofmann, that the Committee of this Society had arranged and approved of the proposal of M. Scheibler, that a photographic album be made to contain the photographic portraits of the members of the *Gesellschaft*, taken in the well-known card size, and each photograph to bear, moreover, the autograph of the member it represents. At the ordinary meeting of the Society, held on the same day, the following papers were read:—

Simple Method for Determining the Percentage of Water contained in Various Kinds of Starch.—M. C. Scheibler.—The author states that he had been requested by a number of starch and glucose manufacturers to try to find a readily-executable, yet reliable method of determining the quantity of water contained in starch, especially in its green, or raw state. M. Scheibler further says, that it occurred to him that, since starch is insoluble in alcohol, and only contains very slight traces of fatty matter, the object to be obtained might be readily attained by determining the change of the specific gravity alcohol suffers after having been for a length of time in contact with wet starch. In order to test this point practically, some preliminary experiments were first made with starch and alcohol of 90° Tralles (equal to 0·8339 specific gravity at 12 4-9ths degrees R.), and afterwards the following mode of testing was devised:—100 c.c. of the alcohol, weighing 83·4 grms., were placed in a glass-stoppered bottle, and thereto was added 41·7 grms. of divers samples of starch, in separate samples, of which the quantity of water therein contained had been previously ascertained with great accuracy. These samples were left in contact with the alcohol for one hour, care being taken frequently to shake the bottle. After that lapse of time, the alcohol was separated from the starch by filtration, and its specific gravity accurately determined. While experimenting, the author observed that, when the starch contains less than 11·4 per cent of water, instead of yielding up water to alcohol of the above-named strength, it withdrew water from that alcohol. The lengthy paper contains several tabulated forms, and is, on the whole, intended especially to aid starch and glucose makers in their business, and the experiments refer to so-called green starch.

Essay on the Affinity in Solutions of Perchloride of Iron, without Change of the State of Aggregation.—M. A. Müller.—The author says, in the introduction to his paper:—Only when the intensity of a coloured solution decreases, by dilution, in the inverse ratio of the increase of bulk, are we entitled to assume that the molecules of the colouring material are simply mechanically put asunder, and not also chemically modified; when, however, the intensity of colour is affected, in a more or less degree, in a different manner, by becoming more dilute, we are almost forced to assume a chemical change. The author next states that, from experiments made by him, and with solutions of chloride of iron and other coloured metallic chlorides, platinum chloride being preferred, he has found that the intensity of the colour of the solution really depends—1st, on the nature of the diluent; 2nd, on the temperature of the solution; and, 3rd, on the age of the solution—*i.e.*, whether recently prepared or not. As diluents, have been applied—water, hydrochloric acid, solution of chloride of ammonium, and solution of chloride of sodium. The experiments made are described at great length. It appears that the addition of hydrochloric acid, chloride of ammonium, and chloride of sodium have the effect of increasing the intensity of colour of a solution of chloride of iron, even after it has been largely diluted with water; increase of temperature has the same effect.

Varying Behaviour of Iodine towards Sulphuretted Hydrogen under Different Conditions, and the Causes thereof.—M. Naumann.—When iodine is dissolved in perfectly anhydrous sulphide of carbon, and dry sulphuretted hydrogen is passed into that solution, no action whatever takes place. Water, as well as an increase of temperature, are required for the formation of hydriodic acid and the separation of sulphur. The author has gone at great length in studying both the thermic and hydric conditions, which are called into play when the two substances alluded to react upon each other; and, in the second part of his paper, discusses—

The Preparation of an Aqueous Solution of Hydriodic Acid.—Several experiments have been made on this subject, and, as result thereof, the author recommends that, first, a concentrated solution of iodine in pure sulphide of carbon be made; this solution to be next diluted with more of the latter fluid, and then only water to be added, previous to the passing of sulphuretted hydrogen gas into the solution.

Essential Oil of Balsam of Peru.—M. Kraut.—The author found that this oil may be separated, by distillation under reduced pressure, and in an atmosphere of carbonic acid gas, into three different oils:—*a*. Boils at 200° C.; contains 76·20 per cent C, and 6·68 per cent H; and is converted, by chromic acid, into benzoic acid, no carbonic acid becoming disengaged. *b*. Boils at 300°; contains 79·09 per cent C, and 6·00 H; an alcoholic solution of potassa converts this oil into benzoic acid and benzylic alcohol. *c*. Boils at about the boiling point of mercury; contains 81·21 per cent C, and 6·12 H; treated with alcoholic solution of potassa, it is converted into cinnamic acid and benzylic alcohol.

On Cumonitrilamine.—M. E. Czumpelik.—The author describes at great length a series of experiments made by him to prepare this base; the description being too complicated for abstraction, we content ourselves with giving the ultimate result of his labours. Cumonitrilamine is a solid substance, readily crystallising, difficultly soluble in water, but readily so in alcohol and ether; fuses at 45° C.; and boils at 305° C. With acids, salts are formed, and with chloride of platinum a beautifully-crystalline double salt is obtained. The elementary organic analysis of this salt gave, in 100 parts, the following result:—C, 32·74; H, 3·54; N, 7·68; Pt, 26·97; Cl_6, 29·07. These numbers lead to the following formula:—

$$C_{20}H_{26}N_4PtCl_6 = 2[C_{10}H_{12}N_2HCl],PtCl_4.$$

The equivalent of this platinum compound is 733.

Base of the Cumin Series, which agrees with Benzylamine.—M. E. Czumpelik.—In this paper, the author tells us how he effected the hydrogenisation of the cumonitrile. While obtaining various intermediate products, he at last got thioamide, an oily liquid, yielding, with hydrochloric acid, a readily crystallisable salt, which combines with chloride of platinum, yielding a crystalline compound, insoluble in water, and soluble in alcohol and ether. This, on being submitted to elementary organic analysis, gave the following results for 100 parts:—C, 33·78; H, 4·15; N, 3·94; Pt, 27·18; Cl_6, 29·95. Formula—

$$C_{20}H_{28}N_2PtCl_6 = 2[C_{10}H_{14}N,HCl]PtCl_4.$$

The equivalent of this platinum compound is 711.

On Trimethylglycerammonium.—M. V. Mayer.—By a complicated set of reactions between substances, the very length of the names of which would occupy too much space. The author succeeded in obtaining a double gold salt of the base named at the head; this salt—

$$AuCl_3N(CH_3)3C_3H_5(OH)2Cl,$$

that is to say, the trimethylglycerammonium chloride of chloride of gold exhibits orange-coloured, very lustrous crystals, soluble in water, as well as in absolute alcohol, and fuses at 190° C. The trimethylglycerammonium chloride is a solid substance, crystalline, soluble in water, and decomposed, by boiling with baryta water, into trimethylamine. The author states that his researches on the trimethylglycerammonium, in free state, are not yet quite complete.

On the Means of Entirely Preventing Bumping of Fluids while Boiling.—M. E. Winkelhofer.—The author reviews what has been done by others, and especially by Dr. Pellogio, and next describes, at length, some experiments of his invention, embracing the following fluids:—Methyl-alcohol, sulphuric acid, alcoholic solution of sulphate of protoxide of iron, alcoholic potassa solution, hydrochloric acid, and dilute sulphuric acid, containing some sulphate of lead. His plan, to prevent bumping, is simply an electric current, led into the fluids by means of suitable conducting wires; his contrivances are very ingenious, but certainly too complicated for general use.

Hypotheses respecting the Constitution of Benzol.—This paper cannot be well understood without the diagrams annexed thereto, upon the value of which the reasonings contained in the paper are based.

This number of the *Berichte* concludes with a brief notice, by M. Rammelsberg, correcting some of Mr. Maskelyne's statements in respect of a meteorite and minerals found therein, and the specific gravity of these minerals. Maskelyne observed in a meteorite from Breitenbach in Bohemia, occupying a middle place between iron and stone meteorites, a mineral embedded in the iron, of 3·3 sp. gr., and having the composition of enstatite. He found another mineral, which yielded, on analysis, from 97 to 99 per cent of silica, and only having the low sp. gr. of 2·1 to 2·2, and is therefore not quartz; Maskelyne says it is optically doubly axial, and takes it as identical with tridymite, which, however, has a sp. gr. of 2·3, and is optically uni-axial.

Der Papier Fabrikant, No. 5, May, 1869.

This periodical, published in Southern Germany, is not a mere trade circular, but a very well got up paper; and, in the present number, an interesting paper is met with on a subject not quite familiar to scientific, and less so to many practical readers, in this country. We abstract some of the leading features of a valuable paper—

On Ultramarine.—M. Zuber.—The beautiful blue pigment now known as ultramarine, and manufactured in France and Germany on a large scale, has become common by the results of scientific and analytical chemistry. The native ultramarine, also called lazulite, lapis lazuli, and zeolite blue, is a rather rare mineral, of which, in pure state, according to Patrin, Central Asia is the native place. This native mineral consists, in 100 parts, according to Varrentrapp's analysis, of:—Silica, 45·40; alumina, 31·67; soda, 9·09; lime, 3·52; sulphuric acid, 5·89; sulphur, 0·95; iron, 0·52; chlorine, 0·42; water, 0·12. According to Field, the formula for this mineral is—

$$6[3SiO_2.NaO.Al_2O_3],FNaS.$$

The finest specimens of native ultramarine are used as precious stones; and some of it is still used by artists, it being prepared for that purpose, in a peculiar manner, chiefly at Rome and Florence. Artificial ultramarine was first made by a process discovered by M. Guimet, in France, in 1826, but kept secret, and remaining so up to the present day. Although the pigment obtained by artificial means is one of great beauty and permanency, under ordinary conditions it is never made equal to the pigment derived from the native *lapis lazuli*. Notwithstanding a large number of scientific and practical men have studied this subject, the precise answer to the question, whence the blue colour of this substance is derived from, is a perfect mystery; the only fact certainly known is, that a portion of the sodium is combined with the sulphur, to form a certain sulphuret, and that that alkaline sulphuret is chemically combined with a double silicate of alumina and soda. Iron and calcium have been proved to have nothing to do with the cause of the blue colour, and to be simply accidental. In the original paper, from which we condense the results, no less than 10 analyses of samples of artificial ultramarine, made by different analysts, and from different makers, are given. Varrentrapp's results are, for 100 parts, as follows:—Silica, 46·60; alumina, 23·30; soda, 21·46; sulphur, 1·68; potassa, 1·75; iron, 1·06; lime, 0·02; sulphuric acid, 3·08; with traces of chlorine, oxide of iron, oxygen, and an accidental trace of clay. The ingredients required for the manufacture of artificial ultramarine are—sulphur, wood charcoal, sulphate of soda, carbonate of soda, and kaolin; curiously enough, the latter substance is preferred from Cornwall, and fetched thence to be transported abroad, while the manufacture of ultramarine in this country is of little or no importance. The product of ultramarine met with in commerce is rarely, if ever, adulterated, unless it be with the pure sulphates of lime and baryta, to reduce the original deep blue colour to a less dark shade. In order to test the colouring value of a sample of ultramarine, it is usual to weigh off 0·1 grm., and to mix it, in a dry state, with 1 grm. of powdered French chalk, and to compare the tinge obtained with other mixtures of the kind and a standard sample of ultramarine. Besides being largely used in oil painting, ultramarine yields blue printing ink, blue for calico, silk, and woollen tissues; for colouring paper, sugar (it is largely used in sugar refineries to brighten the loaf sugar), fresco and stucco painting, and other purposes. All acids, especially the more concentrated ones, destroy the colour, which, however, stands fire, as well as many other agents. The native ultramarine is not affected by acids unless heat is at the same time applied.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, February, 1869.

None of the papers contained in this periodical bear upon chemical science, or subjects more immediately connected therewith.

Annalen der Chemie und Pharmacie, May, 1869.

This periodical contains the following original essays and papers:—

On Indium.—M. R. E. Meyer.—The author opens this lengthy essay with a review of the labours of others on this subject. He then states that the source whence he extracted indium is the zinc from Freiberg, in Saxony. The preparation of the metal, and its purification, are described at great length, but, since no new method was applied, we need not enter into details on this subject. The various combinations of this metal with iodine, bromine, chlorine, cyanogen, sulphuretted hydrogen, and, next, salts of the oxide, are described. The iodide of indium, InI_3, equivalent 329·6, contains, in 100 parts:—Indium, 22·94; iodine, 77·06. The chloride of indium, $InCl_3$, equivalent 146·6, contains, in 100 parts:—Indium, 51·57; chlorine, 48·43. A large number of double salts and compounds of the halogens of indium, with similar compounds of other metals forming double halogen compounds, are described in detail; in fact, the essay is an exhaustive monograph on this subject.

On Lactic Acid and β Iodpropionic Acid.—M. Socoloff.—This essay is a review, rather of what has been done on this subject by other experimenters, than an account of the author's own labours. He states that the β iodpropionic acid was prepared by him in the same manner as was done by MM. Beilstein and Moldenhauer. Several salts of this acid were prepared by M. Socoloff, and submitted to organic elementary analysis. The calcium salt yielded, in 100 parts:—Carbon, 33·08; hydrogen, 4·62; calcium, 18·34; the remainder being oxygen. In a tabulated form, the author records the physical properties of the calcium, barium, zinc, and lead salts of the acid submitted to research by him, and of ordinary lactic acid, paralactic acid, and methylglycolic acid. The lengthy essay winds up with a theoretical discussion on mono-acid, bin-acid, and even hepta-acid alcohols.

Researches on the Derivatives of Salicine.—M. Hugo Schiff.—This paper is the first of a series to be continued by the author on this subject, and this portion is headed—1. *Amide of Salicyl Aldehyde*. The author begins by stating that the formula for the aldehyde of salicyl should be written—

$$C_6H_4\begin{cases}OH\\CHO'.\end{cases}$$

Next, the preparation of this aldehyde is described as follows:—Take, from 300 to 400 grms. of salicine, and the Ettling oxidation mixture (nothing is said as to what this mixture consists of); during the time the distillation is going on, water is allowed to drop continuously into the retort, in order thereby to keep up the original degree of concentration of its contents, and to prevent the formation of resin as much as possible. The aldehyde, after having been separated from the water, is saturated with common salt, and mixed with ether; in this manner, about one-third of the weight of the salicine originally taken is obtained as aldehyde. The author next treats of the products of the action of aniline upon salicyl-aldehyde, and then describes, at great length, several complicated combinations, as, for instance, salhydrethylanilide, formula—

$$C_6H_4\begin{cases}OH\\CH.\end{cases}\begin{cases}NC_2H_5.C_6H_5\\NC_2H_5.C_6H_5\end{cases}-C_{32}H_{36}N_2O;$$

ethylsalhydranilide—

$$C_{15}H_{15}NO;$$

and ethylsalhydrethylanilide—

$$C_{32}H_{30}N_2O.$$

Several metallo-compounds are next described—Copper salhydranilide—

$$C_{26}H_{20}CuN_2O_2,$$

containing, in 100 parts:—Carbon, 68·2; hydrogen, 4·6; copper, 13·7.

Derivatives of Propane.—M. Carl Schorlemmer.—Propane, a hydrocarbon, C_3H_8, is described, first, as regards its preparation from isopropyliodide and zinc turnings; next, a chloride of propane is prepared, which, on being analysed, yielded results leading to the formula C_3H_7Cl. The author describes several experiments, made with the view to obtain chemically pure products, and ends his paper by promising more accurate and full details on this subject.

On Hydroxylurea.—Drs. Dresler and Stein.—When hydroxylamine and cyanic acid act upon each other, a substance is obtained, the composition of which may be expressed by the formula $N_2CH_4O_2$. The authors state how they proceeded to obtain this substance, in a pure state, by a rather complicated and lengthy process. The hydroxylurea is a solid substance, very soluble in water, sparingly in alcohol, crystallising in needle-shaped crystals; it fuses at 130° C., and is decomposed when that temperature is continued, yielding carbonic acid and ammonia. The substance is readily acted upon by caustic potassa and nitric acid; its solutions, in neutral fluids, reduce solutions of salts of silver to the metallic state.

Comptes Rendus des Séances de l'Académie des Sciences, Monday, May 31, 1869 (No. 22).

We notice, in the first place, an abstract of a memoir—

Decomposition of Chloride of Sodium and Chloride of Potassium by Metallic Iron under the Influence of Moist Air.—M. E. Chevreul.—After having entered upon some historical details, and gone back as far as the year 1779, when Scheele experimented on this subject, he proves, by a simple experiment made before the meeting, that, when chloride of sodium, iron, water, and air are in actual contact, decomposition of the alkaline chloride takes place; further, that this decomposition is not, as has often been stated, an effect of efflorescence, but a double decomposition, according to the well-known law of Berthollet, which, however, was rather too vaguely formulated by its original author.

New Spectrum Observations of the Sun's Atmosphere and Protuberances.—Rev. Father Secchi, S.J.—In the shape of a letter, addressed from Rome, and dated May 21st, the eminent *savant* states:—The spectrum observations of the solar protuberances made by M. Rayet, during the eclipse of the sun, in the month of August last year, have revealed a considerable number of luminous rays, seven of which were especially prominent; only four of this number have afterwards, when no eclipse takes place, been found to exist with certainty—viz., the three principal rays of hydrogen, and the yellow ray in the neighbourhood of sodium. It was highly interesting to try whether, under favourable conditions, these three other rays could be again found. I am happy to be able to state that, during my observations yesterday (May 20th), I have succeeded in seeing these rays with perfectly absolute certainty. The author proceeds to describe the exact locality where he discovered these rays, and gives a diagram to illustrate this portion of his letter; and next describes the nature of these rays at length, illustrated by a diagram. It appears, from this description, that the rays exhibit great brilliancy, and are more remarkable, even than could be expected at first from M. Rayet's former observation. The rays are those of magnesium, hydrogen, and a non-gaseous (as yet undetermined) substance.

Scientific Aerostation.—M. Tissandier states that a balloon, of 10,000 cubic metres (about 354,000 English cubic feet) capacity, and of 2500 square metres surface, has been placed, by M. le Ministre de la Guerre, at the disposal of several scientific men, and that it is intended to have (on June 27th and July 11th ensuing, from the Champs de Mars, Paris) ascents with this balloon, the car of which is capable of carrying with comfort ten people, and, in addition, 1500 kilos. weight; members of the Academy desirous of being of the party are requested to state so. This balloon is formed of four layers of tissue, glued together by means of india-rubber, and is to be filled with hydrogen; and experiments already made have proved that it preserves that gas unaltered for a long time.

On a New Thermo-Electric Battery made with Galena.—MM. Mure and Clamond.—This battery is composed of sixty elements, made up of small bars of galena, 40 m.m. in length by 8 m.m. thick, and bars of thin sheet iron, 55 m.m. in length by 8 m.m. in width, and 0·6 m.m. thickness. These materials have been arranged so as to form a hollow cylinder, which, when it is intended to be used, is to be heated by a peculiarly constructed gas burner. The specimen of this battery exhibited at the meeting had an electro-motive force of 1½ Bunsen element. M. Becquerel read a lengthy paper on the subject of this battery, the result of which is, that thermo-electric batteries, constructed either of metallic alloys, or as in this case, of a metallic sulphide and a metal, are not economical in use, and are too liable to changes brought on by the effects of the heat.

The Law of Mariotte, and on the Liquefaction of Gases in Relation to the State of Dryness of these Gases.—M. Dubrunfaut.—Curiously enough, in spite of, and against all evidence to the contrary, the author insists that perfectly pure and dry gases cannot be liquefied by any pressure or any lowering of temperature, however great. He says, the intervention of water is an absolute condition of the condensation of gases to fluids; no wonder that M. Dumas should vehemently protest against a heresy so flagrantly in opposition with experience.

Chemical Constitution of Amylaceous Matter.—M. Musculus.—The author has made a series of experiments, in order to prove that the formation of dextrine from starch is only the first step in the process of splitting up which starch undergoes when it is placed in contact with water and diastase at a temperature of from 60° to 75° C., and that the quantity of sugar obtained by this process represents at least two equivalents. The lengthy paper contains the results of a series of experiments, too long and too many to be further quoted here, but the author has to confess that his main object has not been attained.

Researches on the Ethers of Phenol.—M. E. Lippmann.—The author has studied—*Ethylen-diphenol*—

$$\left.\begin{matrix}(C_6H_5)\\C_2H_4\end{matrix}\right\}O_2.$$

Ethylen-diphenolsulphuric Acid.—The lead-salt of this acid crystallises, and is soluble in hot water, but insoluble in cold water. The analysis of the salt, dried at 120° C., gave, in 100 parts—C, 29·49; H, 2·0; Pb, 35·7. Formula—

$$\left.\begin{matrix}C_6H_4SO_2Pb''\\C_6H_4SO_2\\C_2H_4\end{matrix}\right\}O_2.$$

Ethylen-diphenosulphate of barium. A crystalline powder, not very soluble in boiling water. Its elementary organic analysis gave, for 100 parts:—C, 33·0; H, 2·3; Ba, 26·9. Tetrabromide of ethylen-diphenol is composed, in 100 parts, of:—C, 31·6; H, 2·0; Br, 60·3. Formula—

$$\left.\begin{matrix}C_6H_2Br_2\\C_6H_2Br_2\\C_2H_4\end{matrix}\right\}O_2.$$

The author states that the preliminary note from M. Burr on this subject, published in the *Zeitschrift fur Chemie*, No. 6 (see CHEMICAL NEWS, vol. xix., p. 251), had not come into his possession when he made his experiments.

New and General Method for the Preparation of Nitriles.—M. L. Henry.—The author has succeeded in transforming amides into nitriles, by means of pentasulphide of phosphorus, and has especially operated upon acetamide and benzamide, making use of 1 equivalent of the pentasulphide of phosphorus upon 5 equivalents of the amide. The result of the action of the pentasulphide of phosphorus upon acetamide is aceto nitrile, $(C_2H_3)N$; while the result of the action of this material upon benzamide, is cyaphenine, a polymere of benzonitrile, $(C'''_7H_5)N$.

Physiological Effects of Stanethyl and Stanmethyl.—MM. Jolyet and André Cahours.—The authors describe the preparation of these chemical compounds, which may be obtained by means of the perchloride of tin, Sn_2Cl_4, at great length, and then describe the physiological effects, which are those of stupor, inducing narcotism in the very highest degree.

No. 23, June 7, 1869.

We notice, from this periodical, the following memoirs, papers, and communications, omitting those relating to physiology, medicine, mathematics, and mechanical science:—

Synthesis of the so-called Aromatic Acids.—M. Wurtz.—The author describes, in the following terms, a new method for the synthesis of the above acids:—When an organic chloride, or bromide, is treated with chloroxycarbonic ether and sodium amalgam, the haloid element is eliminated by the sodium, and replaced by the group $CO_2(C_2H_5)$; if it is, therefore, required to convert a carbide of hydrogen into a higher monocarbon acid of the series, the monochloride or monobromide of that carbide of hydrogen is first prepared, and then heated with chloroxycarbonic ether and sodium amalgam. The author next proceeds to describe some experiments made by him, and the results obtained, at length; starting with bromide of phenyl, C_6H_5Br, and mixing this chloroxycarbonic ether and sodium amalgam, the following formula represents the reaction, resulting in the formation of benzoic ether:—

$$C_6H_5Br+CO\left\{\begin{matrix}O.C_2H_5\\Cl\end{matrix}\right.+Na_2=NaCl+NaBr+C_6H_5.CO_2(C_2H_5).$$

Use of the Spectroscope to Distinguish a Feeble Light, Present with a Stronger Light.—M. Seguin.—The author describes a series of experiments with electric light, and observations thereon with Duboscq's vertical spectroscope. The result and conclusion arrived at is, that the spectroscope serves eminently the purpose of detecting (proved, also, by the observations made with it of the sun's light and protuberances) a more feeble light present along with a much stronger, and the former of which would be invisible to the naked eye, or by means of other optical instruments.

On Acetochlorhydrine and Octylglycol.—M. de Clermont.—Into 50 grms. of anhydrous acetic acid, strongly cooled, anhydrous hypochlorous acid is passed, until the acetic acid has absorbed 10 grms. of the latter; no stronger solution should be made, as there is danger of explosion. To the mixture of acetate of chlorine and anhydrous acetic acid is added a quantity of 14 grms. of pure octylen, previously mixed with anhydrous acetic acid; acetochlorhydrine is thus formed, which, being held in solution by the acetic acid, is separated therefrom by addition of water. The acetochlorhydrine of octylen is a highly mobile liquid, devoid of colour, of agreeable and aromatic odour, soluble in alcohol, ether, and acetic acid, insoluble in water, burns when ignited, with a sooty greenish-bordered flame, and boils, without decomposition, at 225° C. The specific gravity of this liquid is, at 0° C., 1·026, and it consists, in 100 parts, of:—C, 58·11; H, 9·20; Cl, 17·19. Density of vapour, 7·12.

Acetic Derivatives of Mannite.—M. E. Grange.—When crystallised mannite is heated, in an open vessel, with strong acetic acid, and boiled, there is left, on cooling, a crystalline mass embedded in a syrupy liquid; the latter is separated by filtration over asbestos, and the dry solid residue washed with strong absolute alcohol, to eliminate the acetic acid. The material, thus purified, is hardly soluble in boiling alcohol, not at all in ether, and very soluble in water and acetic acid. Submitted to analysis, it yields, in 100 parts:—C, 45·42; H, 7·027; O, 47·553; corresponding to the formula $C_{14}H_{24}O_{11}$, equal to $C_{12}H_{22}(C_2H_3O)O_{10}$. The author describes a series of results of experiments of various reactions of divers substances with this compound, but our space does not permit us to enter into details.

We only notice the titles of the two next papers, which are not suitable for abstraction:—

Observations on the Phenomena of Supersaturation.—M. Margueritte.

Second Notice on the Theory of Supersaturation and Solution.—M. Lecocq de Boisbaudran.

Salts of Phenetolsulphuric Acid.—MM. Opt and Lippmann.—Phenetol—

$$\left.\begin{matrix}C_6H_5\\C_2H_5\end{matrix}\right\}O,$$

is a liquid, boiling at 168° C. When sulphuric acid is added to it, a pink colour ensues, and, after the mixture has been heated upon a water-bath for about an hour and a half, a crystalline mass is formed; this is dissolved in much water, treated with baryta water, and the excess thereof eliminated with carbonic acid. In this manner, a beautifully crystallising baryta salt of the phenetolsulphuric acid is obtained; the composition of this salt, in 100 parts, is:—C, 35·62; H, 3·03; Ba, 25·04; H_2O, 11·78. The formula is—

$$(C_6H_4SO_2C_2H_5O)_2Ba''+4H_2O.$$

The authors briefly describe the lead and potassium salts of this acid.

Elimination of the Nitrogen contained in Beet-Roots during the Process of Manufacturing Sugar therefrom.—M. A. Renard. This paper is chiefly of importance to beet-root sugar makers.

On the Meteoric Stone Fallen from the Sky, on the 22nd of May, 1869, at Cléguérec, Département du Morbihan, France.—M. Limur states that, on the evening of the 22nd of May last, at 9·45 p.m. local time, there was heard at Vannes, the capital town of the department, a heavy report, like that due to the firing of large ordnance, while the sky was at the same time illuminated by a bluish white light, accompanied by sparks somewhat like those of fireworks. The next day the author learned that, at Cléguerec, a meteoric stone had fallen, which had been broken into pieces by the peasantry, and fragments of which, weighing 22 and 16 kilos. had been secured by some parties, who, knowing the value scientific men attach to these extra-terrestrial visitors, will shortly send them to Paris for investigation.

Palladium and Hydrogen.—M. Favre states that, according to his experiments, the hydrogen in palladium saturated therewith is present as a chemical compound, and not simply in the state of condensed gas. The author also states that the vapour of boiling mercury is as little a conductor of electricity as hydrogen is, and that, therefore, the non-conductibility of hydrogen for electricity cannot be regarded as an objection to its being a metal.

Cosmos, No. 23, June 5, 1869.

The only communication contained in this number suitable for translation to our pages is—

New Marking Ink for Linen.—M. Kuhr recommends the following preparation:—One part of hypophosphite of soda, and two parts of gum arabic are dissolved in sixteen parts of distilled water. The tissue, linen, or cotton to be marked is thoroughly moistened with this liquid, and then left to dry. After having become well dried, the following liquid, composed of one part of nitrate of silver, and six parts of gum dissolved in six parts of distilled water, is used as marking ink, with a quill pen. The mixtures here described are stated to yield an indelible, and very deep black-coloured ink.

Bleaching Soap.—This is a soda soap prepared according to the excellent prescription of the Prussian Pharmacopœia, which prescription has been copied in almost all other works of the kind; the soap is separated by common salt, and after this one-fourth of its weight of sulphite of soda is added, which has been previously made into a homogeneous paste by means of a little water; the soap is next dried in the usual manner. In order to apply this soap, chiefly intended for the bleaching of straw hats, but perfectly fit for application to silk and wool, it is dissolved in its own weight of cold water, and to every 2 lbs. of soap, ½ oz. of liquid ammonia is added. As soon as the mass has assumed a gelatinous aspect, 1 part thereof is dissolved in 8 parts of warm water. The materials which it is desired to bleach are washed and scrubbed by means of a brush in this soap-sud; while yet moist, the materials are placed in acidulated water (25 parts of water and 1¼ of hydrochloric acid), left in this liquid for 2 hours, and then well washed, and rinsed with pure cold water, and dried. This soap is very largely and successfully used in Russia, and was first prepared in that country by Dr. Werner.—*Pharm. Zeitschr. f. Russl.*

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1243. A. Borgnet, Swansea, Glamorganshire, "An improved composition to be employed as a paint."—Petition recorded April 22, 1869.

1539. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved process for obtaining gelatine and other products from animal substances."—A communication from D. K. Tuttle, O. Lugo, W. J. Hooper, and T. Hooper, Baltimore, Ma., U.S.A.—May 19, 1869.

1575. C. W. Siemens, Great George Street, Westminster, Middlesex, "Improvements in calcining and smelting ores, and in furnaces and apparatus employed in connection therewith, which furnaces are also applicable to other purposes."—May 21, 1869.

1582. H. R. Lumley, St. John's Wood, London, "Improvements in treating and purifying crude iron, and in making steel, and in an apparatus for such purpose."—May 22, 1869.

NOTICES TO PROCEED.

106. C. P. Coles, Mountfield, Bonchurch, Isle of Wight, "Improved means of protecting the bottoms of ships, or other submerged structures, from fouling."—Petition recorded January 13, 1869.

130. P. Spence, Newton Heath, Manchester, "Improvements in the production of sulphate of potash for the manufacture of alum."—January 15, 1869.

148. F. Braby, Camberwell, Surrey, "Improvements in the commercial manufacture of sulphate of ammonia."—January 16, 1869.

186. H. A. Bonneville, Paris, "Improvements in the manufacture of illuminating gas, and of sponge, by the action of hydrocarbon liquids, or fluids, on metallic ores, and in the furnaces for melting said sponge and other metals."—A communication from C. J. Caumon, Toulouse, France.—Petition recorded January 20, 1869.

223. W. M. Welling, New York, U.S.A., "Improvements in compositions resembling ivory."—January 25, 1869.

246. C. Gil, Boulevard des Capucines, Paris, "Improvements in the manufacture of sugar."—January 26, 1869.

252. T. Vaughan, Middlesborough-on-Tees, Yorkshire, and J. W. Smith, Manchester, "Improvements in treating smoke and soot for the preparation of an article of commerce therefrom."—January 27, 1869.

262. A. C. Pass, Bedminster, Bristol, "Improvements in the method of, and apparatus for, condensing and purifying metallic and other fumes, vapours, gases, and smoke, and in obtaining oxide of zinc."—January 27, 1869.

287. F. Jay, South Lambeth Road, London, "Improvement in the manufacture of oil paint."—January 29, 1869.

330. C. D. Abel, Southampton Buildings, Chancery Lane, "The production of a new or improved hydraulic cement or artificial stone."—A communication from J. A. Dubus, Rue Aubert St. Denis, near Paris.—February 3, 1869.

355. F. Braby, Camberwell, Surrey, "Improvements in the treatment and utilisation of the waste solution of sulphate of iron, resulting from the cleansing of iron surfaces in the process of galvanising."—February 5, 1869.

376. E. Meldrum, Dechmont, Linlithgow, N.B., "Improvements in the manufacture of paraffin oil."—February 6, 1869.

753. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the preparation of artificial fuel, and in the manufacture of gas and coke therefrom."—A communication from J. M. J. C. Du Lin and J. A. C. d'Almas, Paris.—March 11, 1869.

1260. J. Major and W. Wright, Swallow Street, Middlesex, and G. H. Jones, Alpha Road, Middlesex, "A new or improved manufacture of white lead, and apparatus employed therein."—April 24, 1869.

1409. F. C. Knowles, Lovell Hill, Berks, "A new or improved method of purifying and converting cast-iron into malleable iron, or into steel, and for the making and use of materials and appliances for the same."—May 8, 1869.

1426. W. E. Newton, Chancery Lane, "An improved process and composition for hardening common or grey cast-iron, and for converting articles of iron into steel, or imparting thereto a steely character."—A communication from B. W. Nichols, Canton, Ohio, U.S.A.—May 10, 1869.

1431. H. Bessemer, Cannon Street, London, "Improvements in the manufacture of malleable iron and steel, and in furnaces and apparatus employed for their fusion and treatment."

1432. H. Bessemer, Cannon Street, London, "Improvements in the construction and mode of working furnaces and apparatus employed in fusing malleable or wrought-iron and steel, and pig or other carburets of iron, and obtaining cast-steel, or homogeneous malleable iron therefrom."

1433. H. Bessemer, Cannon Street, London, "Improvements in the conversion of fluid crude iron, and molten pig or other carburets of iron, into fluid homogeneous malleable iron and steel, whether such pig or other crude iron is used alone, or is mixed with a portion of malleable, or more or less decarburised iron, in a solid or fluid state."

1434. H. Bessemer, Cannon Street, London, "Improvements in the treatment of crude, or pig-iron, and other carburets of iron, and in the apparatus employed for such purposes."

1435. H. Bessemer, Cannon Street, London, "Improvements in the construction and mode of working blast furnaces employed for smelting the ores of iron, and in the mode of employing and utilising the gaseous products of such furnaces, and also in the construction and mode of working blast engines employed to force air into blast and other furnaces."—May 10, 1869.

1582. H. R. Lumley, St. John's Wood, London, "Improvements in heating and purifying crude iron, and in making steel, and in an apparatus for such purpose."—May 22, 1869.

NOTES AND QUERIES.

Picrates.—"T. E. D." is referred to either Watts's "Dictionary of Chemistry, the *Handwörterbuch der Reinen und Angewandten Chemie*, vol. vi., or any treatise on chemistry, wherein he will find the required information, too long for the space at our disposal in Notes and Queries.

Recovered Grease.—We do not quite understand the meaning; for, as long as grease is not saponified, or otherwise altered, or purposely adulterated, so as to become thereby unfit for use, it remains grease to all intents and purposes, and its physical and chemical properties remain then, of course, unaltered.

Scale of Temperatures.—The latest edition of Gehler's extensive *Physikalisches Lexicon*; also the works of Karmarsch, and Prechtl's *Technologische Encyclopedie*, contain what is desired by our correspondent, who will find these works either in the library of the British Museum, or that of the Commissioners of Patents.

Ineradicable Writing.—A French technical paper, specially devoted to the art and science of paper manufacture, states that any alterations or falsifications of writings in ordinary ink may be rendered impossible by passing the paper upon which it is intended to write through a solution of 1 milligram (0·01543 English grain) of gallic acid in as much pure distilled water as will fill to a moderate depth an ordinary soup-plate. After the paper thus prepared has become thoroughly dry, it may be used as ordinary paper for writing, but any attempt made to alter, falsify, or change anything written thereon, will be left perfectly visible, and may thus be readily detected.

New Sulpho-Salts.—Can any one explain the notation and formulæ of Schneider's new sulpho-salts? If the new notation be intended, the nearest approach would be, in old terms,—

			Schneider.
$KS+Fe_2S_3 =$	K	19·6	24·59
	Fe	37·6	35·19
	S	42·8	40·22
		100·0	100·00

But the bismuth salt is much more discrepant.—CHEMICUS.

["Chemicus" is reminded that all formulæ and all cyphers are correctly reproduced from the original papers they are taken from; and that the authors, and not we, are responsible for the formulæ, &c., which we have no right to alter or change.—*Ed.* C. N.]

"On Employment of Constant Factors in Calculation of Indirect Analysis."—The following appears to me to be a more simple and more easily recollected method for determinations by indirect analysis:—Presuming the salt is ascertained to be a mixture of the chlorides of potassium and sodium, and the amount of chlorine has been determined, calculate the weight of NaCl corresponding to the weight of chlorine found; then, since for every molecule of NaCl that is replaced by KCl there will be an increase of weight equal to 15 (*i.e.*, the difference between K and Na), the *difference* between the calculated weight of NaCl and the weight of the salt, being due to the extra weight of K over Na, will, if divided by 15, give the number of atoms of Na which are replaced by ⅋ in the mixture; and the number of atoms, multiplied by the atomic weight 39, will give the weight of potassium, which, together with the weight of chlorine, being deducted from weight of salt, will give the weight of sodium. A general formula may also readily be used for determination of any substance formed by three elements—

Let (*a*) be the combining equivalent of the heavier element;
Let (*b*) be the combining equivalent of the lighter element;
Let (*c*) be the combining equivalent for the determined element.

$$(a^m + b^n + c^m + n)$$

will then be the formula for any such compound; let it be equal to (*x*), calculate—

$$(b^m + n + c^m + n);$$

let it equal (*y*); then—

$$\frac{x-y}{a-b} \times a$$

will give the weight of (*a*) contained in the substance.—M. P.

MEETINGS FOR THE WEEK.

WEDNESDAY, 23rd.—Geological, 8.

THURSDAY, 24th.—Zoological 8.30.

—— Royal Society Club, Anniversary. 6.30.

THE CHEMICAL NEWS.

VOL. XIX. No. 499.

THE FARADAY MEMORIAL.

THE Faraday Lectureship has been worthily inaugurated. M. Dumas, representing not alone the chemists of France but the chemists of Europe, has given us a lucid and comprehensive discourse, in which he has surveyed, from our present stand-point, the position of chemistry and its relations with past science, and has, moreover, pronounced an admirable *éloge* of him whom the discourse commemorates. No one could be more eminently fitted than M. Dumas to undertake this duty: he was the intimate friend of Faraday, and with him he somewhat connects the chemistry of the past with the chemistry of our day; he stands pre-eminent among the chemists of his country, and has had much influence upon the entire *cultus* of France during the last quarter of a century. And what are his relations with the past? He was born a few years after the death of Lavoisier; at the time when he entered the chemical world the system of Lavoisier was firmly established, was universally accepted. He may have seen as a boy the death of Phlogiston—that slow, long-drawn-out death, not with gasping and a discoloured visage, not with a strong clinging to life and mortal strugglings; it was rather the death of the aged and worn-out, almost a euthanasia. Phlogiston died as an old king, once infinitely dominant, somewhat tyrannical, not always just; now deposed, decrepit, utterly senile, forsaken by all, and ever harping upon his former glories. It was Lavoisier who founded the new dynasty, of which ours is as much a continuation as was the dynasty of Elizabeth of that of Henry VII. The times have changed, the *modus* of thought has changed, characteristic developments have assumed new features, and appeared with altered and contingent phases; but the basis is the same—it is firm and immutable as to its facts; and all philosophy, of what kind soever it be, all science, all social actions, are alone stable when they are founded upon the immutability of fact. We were glad to notice that M. Dumas made much mention of Lavoisier in his discourse; but not glad to observe that, while the names of Davy and Dalton were received with applause, that of Lavoisier was passed in silence. This is ungenerous and illiberal. We need not go quite so far as M. Wurtz, in his recent "History of Chemical Theory," but let us at least acknowledge to the full that which Lavoisier has done for chemistry. In neglecting him, we not only act unjustly, but we injure ourselves; for, did not Lavoisier confess himself the pupil of Black? And, as to the arrogance attributed to him in regard to the name of his chemistry, it seems to be forgotten that Fourcroy introduced the term *La Chimie Française;* it was a just term, and, till lately, no one has complained of it. Does not Davy speak of the "new French chemistry?" Let us forget these petty jealousies. The very institution of the Faraday lectures will, by establishing cordial unions between scientific men of foreign countries and those of our own, help to dissipate these feelings, and to produce a more complete *entente cordiale*. Meanwhile, let us express for Lavoisier, in the words of M. Dumas (in his admirable "Leçons sur la Philosophie Chimique"), "notre profonde admiration pour son génie, et notre douleur éternelle pour sa mort prématurée." And let us express, for M. Dumas himself, the first of these sentiments, and thank him for having come among us; this man, who was a great chemist before many of us were born; who, more than forty years ago, wrote a many-volumed work on chemistry, which has been the text-book of a generation or so of young chemists; and who has ever furthered and adorned our science.

A word or two, about the medal which accompanies the Faraday lectureship. Of the design, and the legend which accompanies it, we fear we cannot speak in great praise, and therefore shall not speak at all; but some may be interested in knowing that the medal is to be struck in palladium, and that a quantity of this rare metal, sufficient for the medals of at least ten years to come, has just been presented to the Chemical Society by an eminent metallurgical firm. And, *apropos* of this, we may mention that M. Dumas carries back to France with him, in addition to the Faraday medal, a medal of the alloy of palladium and hydrogenium to commemorate the discovery of the latter by the Master of the Mint.

It is a matter of much satisfaction to know that at length steps have been taken to provide a memorial to Faraday in another form. While the lectureship and medal are the special memorial of the Chemical Society, this is to be the memorial of the country at large, and it is proposed that it should take the form of a statue. That the Government have held aloof from taking any part in this memorial is much to be regretted, but the Chancellor of the Exchequer has stated that he is only following precedent in not allowing public monies to be expended on a memorial to a "private citizen." But was Faraday a *private citizen?* In one very limited sense, indeed, he was, but, in point of fact, he was a cosmopolitan. "Faraday," said M. Dumas, "n'appartient pas seul à l'Angleterre,

il appartient à tout le monde." A private citizen! Who has worked more for the public good? Who has more promoted works for the weal of his country, for the welfare of his race? We hope that not only the scientific men of this country will promote the Faraday memorial, but that the whole country will subscribe to it, and that we may have not alone a statue to this great man, not alone the lectureship and medal, but some greater work, and we would suggest, as we have before done, that it should take the form of a Public Laboratory, which would afford to those who have longings for science, but who lack opportunity, a means of satisfying the yearnings of their genius. To those who "fall gloriously fighting" in the service of their country,—to those who in the Senate have promoted large interests, successful negotiations, an honourable peace, or a triumphant war,—the country and the Government never fail to raise memorials, and to give honour: let them honour him who, working quietly, and steadily, and firmly, has added so much to the internal wealth of this country, so much to the scientific literature of the world. Faraday ever held in his hand "Lampas investigationis, non torris contradictionis," and the bright steadfast light illumines all that he did, and enveloped him as he passed untimely from our sight.

ON THE

ATOMIC WEIGHTS OF GOLD, PLATINUM, IRIDIUM, OSMIUM, RHODIUM, AND PALLADIUM.

By W. M. WATTS, D.Sc., F.C.S.

THE atomic weight of gold was determined by Berzelius from the analysis of its double chloride with potassium. He obtained, as mean result, the number 196·67, which was calculated from the weight of potassium chloride left, assuming its atomic weight = 74·57. My pupil, Mr. R. A. Jones, has pointed out that, since Berzelius determined in each case not only the potassium chloride left, but also the metallic gold set free, we have data for calculating both the atomic weight of gold and also that of potassium; so that, by comparing the atomic weight of potassium calculated from Berzelius's numbers with that given by the marvellously accurate researches of Stas, we are able to estimate the degree of accuracy of Berzelius's results. Berzelius obtained (*Lehrbuch der Chemie*, iii., 1212), in four experiments, the following results:—

	$AuKCl_4$. Grs.		KCl. Grs.		Au. Grs.
(1).	4·14450	gave	0·81850	and	2·15900
(2).	2·24950	,,	0·44425	,,	1·17200
(3).	3·41300	,,	0·67400	,,	1·77725
(4).	4·19975	,,	0·82950	,,	2·18800

Calculating from Stas's number for chlorine, viz., 35·457, we obtain the following atomic weights for potassium and gold:—

No. of Experiment.	Atomic weight of Potassium.	Atomic Weight of Gold.
1	39·149	196·79
2	39·166	196·87
3	39·088	196·57
4	39·176	196·86

If we select experiments 3 and 4 as the best, and take the mean, we have K = 39·132, and Au = 196·71.

The extremely close agreement of the numbers for potassium with that given by Stas, viz., 39·133, can be considered as little less than marvellous, and may, I think, be regarded as investing the atomic weight of gold with authority scarcely less than could be obtained by a repetition of the determinations, with all the minute precautions which Stas employed in his experiments.

It must not be forgotten, however, that in this way we check only the accuracy of manipulation, but obtain no evidence of any error arising from impurity of the metal employed.

I have applied the same criticism to the results obtained in precisely the same way for platinum, iridium, osmium, rhodium, and palladium, none of which, however, exhibit the accuracy of the gold determinations; and the best result is probably obtained by calculating from the atomic weight of potassium chloride instead of from chlorine alone.

The results are subjoined—

	Calculated from Cl = 35·457.		Calculated from KCl = 74·59.	Authority.
Platinum	K = 39·35	Pt. = 197·75	Pt. = 197·18	Berzelius
Iridium	K = 39·39	Ir. = 197·54	Ir. = 196·87	,,
,,	K = 39·87	Ir. = 198·56	—	Claus
,,	K = 39·93	Ir. = 196·62	—	,,
Osmium	K = 39·28	Os. = 199·42	Os. = 199·03	Berzelius
Rhodium	K = 39·12	Rh. = 104·21	—	,,
,,	K = 39·89	Rh. = 104·76	—	,,
Palladium	K = 39·62	Pd. = 107·19	Pd. = 106·57	,,

Manchester Free Grammar School,
June 18th, 1869.

ON THE

ACTION OF HYDROCHLORIC ACID ON CODEIA.*

By AUGUSTUS MATTHIESSEN, F.R.S.,
Lecturer on Chemistry in St. Bartholomew's Hospital,
and C. R. A. WRIGHT, B.Sc.

CODEIA was sealed up with from twelve to twenty times its weight of strong hydrochloric acid, and heated to about 140° for two or three hours. After cooling, a layer of colourless liquid was observed floating on the top of the brown tarry contents. It immediately became gaseous on opening the tubes, and was presumedly chloride of methyl, as the issuing gases were found to be free from carbonic acid. The residue in the tubes, when dissolved in water and precipitated by carbonate of sodium, yielded, on extraction with ether and agitation with hydrochloric acid, a crystalline chloride, having when purified by recrystallisation, all the properties of the chloride of apomorphia derived from morphia. It gave the same qualitative reactions, produced the same remarkable physiological effects, and yielded numbers on combustion with chromate of lead and oxygen agreeing with the formula $C_{17}H_{17}NO_2HCl$. Hence the reaction which takes place is in accordance with the formula—

Codeia. Apomorphia.

$$C_{17}H_{17}CH_3HNO_3 + HCl = CH_3Cl + H_2O + C_{17}H_{17}NO_2.$$

Manufacture of Sugar.—The *Journal des Fabricants de Sucre* states that experiments are now in progress in some French colonies, to try, on the large scale, Messrs. Rousseau and Bonnaterre's plan of converting the saccharine juice of cane or beet-root into a peculiar saccharate of lime, and to transport that salt, instead of raw sugar, for the purpose of refining. It is said that this compound is as hard as sand, and can be transported without the risk of damage and injury sugar is subject to, and be kept for any length of time.

* Abstract of a paper read before the Royal Society, June 10th, 1869.

CONTRIBUTIONS TO ANALYTICAL CHEMISTRY.*

By DR. E. FLEISCHER, of Dresden.

NORMAL LIQUIDS FOR VOLUMETRIC ANALYSIS.

IN the greater number of analytical examinations of free acids and alkalies, the rule is to employ a normal acid, and a normal solution of caustic potash, and also a ten-fold dilution of them (1-10th of the normal liquids). In choosing the most appropriate acid for this purpose, it must be taken into consideration that it should form with alkalies or alkaline earths only soluble salts, in order that certainty in discerning the change of colour in the liquid under examination—which is coloured with litmus—may not be injured by precipitates, and also that the carbonates of the alkaline earths may be perfectly transformed by the normal acid. On this account, nitric acid is much more useful as a normal liquid than sulphuric or oxalic acid; but hydrochloric acid is quite as appropriate as a standard solution as nitric acid, and more so, inasmuch as it is more easily obtained pure, and is more constant to one standard, while nitric acid is generally more or less contaminated by nitrous acid. Another advantage possessed by hydrochloric acid is, that the acid contained in it may be not only estimated alkalimetrically, but also quickly and exactly by a standard silver solution, a trial which is impossible in the case of nitric acid.

With regard to volatility, it is to be mentioned that hydrochloric acid, diluted to one-fifth of the normal strength, when heated for ten minutes, whilst replacing the evaporating water, will not impart the slightest tinge of red to a blue litmus paper held in the vapours evolved, and, as in alkalimetric investigations the dilution is much greater, there need not be any fear of ever driving off the free acids by digestion. Moreover, since the constancy of normal hydrochloric acid is so great that, after keeping for months, the slightest change can scarcely be perceived, provided it has been preserved in bottles well closed with glass stoppers, no impediment exists in this respect to its employment as a standard liquid.

It is well known that many chemists besides myself have performed these experiments successfully with normal hydrochloric acid, and that, in all alkalimetrical determinations, they already use it instead of normal sulphuric or oxalic acid; it is hoped, therefore, that these remarks will suffice to demonstrate the utility of this testing liquid.

The second important normal solution for analysis by saturation is normal caustic potash or soda. These caustic liquids should be completely and absolutely free from carbonic acid, and, in order to prevent them from absorbing this gas from the air, a mixture of Glauber's salt and caustic lime is employed. This is contained in a tube fastened into the stopper of the bottle which contains the alkali; but this precaution does not always suffice to retain the solution of caustic alkali perfectly free from carbonic acid, for it almost always happens that an addition of a solution of chloride of barium to it produces a precipitation of carbonate of baryta in greater or smaller proportion. The preservation of caustic alkali by this means is also inconvenient, as, on account of the syphon in the bottle, it requires to be placed over the working bench, and can, therefore, only be protected from the dust by a special cover. To these drawbacks may, perhaps, be ascribed, in technical laboratories, the frequent substitution of the more easily preserved, though less appropriate, solutions of carbonate of potash or soda for the caustic alkaline solution as a normal standard liquid.

All these inconveniencies, which exert more or less influence upon the exactitude of estimation, may, however be remedied by employing, instead of the normal potash or soda solution, caustic ammonia of half the normal strength. Of all caustic solutions, caustic ammonia displays the most complete indifference to carbonic acid; so complete, in fact, that a flask half filled with half-normal ammonia, well closed with a glass stopper, and which was frequently opened for estimations to be made, gave such slight indications of carbonic acid after three months' preservation, that, upon half filling a large test-glass with it, and adding some drops of concentrated acetate of lime, no perceptible turbidity ensued, even on heating; whereas two bubbles of carbonic acid gas introduced into it from a gasometer instantly produced a considerable deposit. Moreover, the standard of this half-normal liquid was so slightly altered during the three months, that 1-10th c.c. of a tested normal muriatic acid was scarcely less saturated by 50 c.c. of it, than would have been necessary by an exact standard.

It follows from these experiments that the half-normal ammonia liquid is at least as useful in acidimetrical work as the best caustic potash solution; besides which, the former has the advantage of being conveniently preserved, and of being easily obtainable chemically pure.

With respect to the importance of the appearance of a blue colouration of the litmus by a liquid reddened by free acid, so as to fix the final reaction in analysis by saturation, the following is worthy of remark:—

Cold diluted (to at least 1 : 10) solutions of neutral sulphate or nitrate of ammonia scarcely produce any perceptible change in blue litmus paper—at any rate, much less than that produced by the introduction of two bubbles of carbonic acid. Sal-ammoniac reacts, under these circumstances, as neutrally as chemically-pure chloride of potassium, or chloride of soda; and a single drop of half-normal ammonia produces in such litmus-coloured solutions a strong and lasting blue colour, slightly inclining towards violet.

Hot solutions of the ammoniacal salts in question, and especially sulphate of ammonia, act upon litmus in a somewhat acid manner, about the same as free carbonic acid; hence it follows that, in all estimations by ammonia, the liquid to be tested should be cold. Should it have been previously heated, it is advisable that it should be cooled as much as possible by first exposing it for some minutes to the air, and then setting it in cold water. If this be attended to, the distinctness of the tint will leave nothing to be desired. The objection may be raised, that ammonia cannot be employed, like potash or soda, as a normal, but only as a half-normal, liquid; the relation of the base to the acid as 2 : 1 is, however, more advantageous to the exactness of the determination than if both fluids possessed the same equivalents.

As all volumetric estimations, excepting those of such caustic liquids as caustic soda, potash, baryta, and ammonia, are finished by re-estimating the acid with ammonia, and, as 1 c.c. of normal muriatic acid corresponds with 2 c.c. of half-normal ammonia, the re-estimation is much more exact than if solutions were used containing equal equivalents. The usual 1-10th normal solutions may also hereby be dispensed with in almost all cases, if the experiments be carefully carried out. These remarks will demonstrate that I can specially recommend the employment of half-normal ammonia and of normal muriatic acid as standard liquids for analysis by saturation; at the same time, I may observe that, for testing acids combined with metallic salts, I employ normal potash, supersaturating with a measured quantity of muriatic acid the free potash present in an aliquot part of the filtrate, calculating the combined acid after removing the carbonic acid by heat, and re-estimating with ammonia.

The standard of the normal muriatic acid is ascertained by a weighed amount of pure carbonate of lime, slightly heated. The best way to preserve both liquids is in well-closed flasks, with glass stoppers. They should be placed in a cool place, free from dust. In hot summer weather, the flask containing the half-normal ammonia should be placed in cold water, which should be renewed daily, because a continued temperature of 25° C. will alter its standard, though only in a slight degree.

* Communicated by the Author.

ON THE

EXAMINATION OF WATER FOR ORGANIC MATTER.*

By R. ANGUS SMITH, Ph.D., F.R.S., &c.

(Conttnued from page 282.)

Let us now consider what does take place during putrefaction. In all cases known to me, the first thing that occurs is the diminution of oxygen in the air absorbed by the water, and, to a more or less extent, the production of sulphuretted hydrogen, which, however, may exist in the water to a very small extent at a time, being rapidly converted into combined sulphuric acid when oxygen can be found for the purpose.

In Loch-Katrine water, the oxygen found in the absorbed air, by Dr. Peany, was equal to 31·69 per cent; that of the Manchester water is equal to 27 per cent. In the Liverpool water, at the bottom of the reservoir, the amount fell to 12 per cent, being equal on the surface to the Manchester. In the first case, as well as in the second and similar cases, the amount of oxygen is too great to allow of putrefaction; and in the third case it was very clear that the oxidation was a process of decolourisation, at least in part, whatever else may have occurred. This decolourisation is caused by the oxidation of the *humus* and its removal as carbonic or other acid.

The gases of pure water contain nearly 34 per cent. of oxygen.

Dalton found cistern-water almost entirely deprived of its oxygen; and I have found every percentage of oxygen from 34 downwards.

I go further into this point in my chapters on water, which I hope to bring out soon. Meantime I may say that the examination for oxygen is a very important one.

Another important feature in putrefaction is the occurrence of carburetted hydrogen. The carbonaceous or organic compound, having lost the ties that bound it together, is broken up into fragments. The carbon, when it can find oxygen, goes off in its company, but otherwise it leaves with hydrogen; separate, however, it must, and that with considerable violence. When there is a great amount of oxygen these decompositions of organic matter do not take place; and even if the Loch-Katrine and other water were largely supplied with organic matter, putrefaction would be entirely absent, as it now is, as long as the high amount of oxygen was kept up in continual presence.

That organic matter does exist in peaty water to a larger extent than in streams not peaty, but still offensive, may be taken for granted. A very brown water contains about four grains per gallon. It is extremely dark, indeed, if there are six grains; but, without peat, putrefaction, or, what is still worse, the development of mischievous germs, may occur, whilst in the other they seem stifled. How far this disinfecting and preserving quality of peaty matter will act in weak solutions I cannot tell; but in its greatest strength (that is, surrounded by the matter of the peat itself), preservation may exist for an indefinite time; and the non-occurrence of putrefaction in weaker solutions may be considered sufficient to show that there is abundant antiseptic power for the amount of matter to be preserved in these waters.

But the question still arises, what is this organic matte containing nitrogen? If it is albumen it is disinfected, if the peat is great in amount; and it is incapable of putrefaction, if the oxygen is great.

We are not perfectly sure that these ammoniacal humates of Mulder's actually exist in the form he mentions. It may be that the nitrogen is otherwise combined, giving another mode of explaining the conditions of the water. If they are combined, as Mulder believes, we have only to allow oxygen to enter the brown water and be absorbed, a process which readily occurs; the *humus* is bleached, and the ammonia is free to combine with carbonic acid, and readily to dissolve a fresh portion of the same salts of which it formed a part. If the nitrogen be otherwise combined, whether as albumen or any similar substance, the oxygen would still play a corresponding part.

By this view of the subject, the brown waters would be giving off carbonic acid, freeing and losing some carbonate of ammonia. When oxidation takes place, a certain acidity is found, coupled with a little bitterness, a quality possessed by great portions of the waters of the hills. This, I believe, occurs in those waters which have not been purified by descending deep into the earth (where thorough oxidation and sweetening take place), but which have passed only over the surface, and been partially oxidised. The complete oxidation produces carbonic acid; the restricted oxidation an acid that is not volatile, and is extremely bitter. I have prepared so little of this, that I am unable to give a good account of it. It was formed from extremely brown water, chiefly from the river Avon, in Lanarkshire. By its formation, the water became very bright; when boiled down, the acid became stronger to ordinary tests, and its bitterness became more intense.

I may remark, by the way, that in all the bottles in which this occurred there was a deposit of very fine flakes of silica, leading me to think that, by our usual modes of estimating that substance, we were apt to make the amount too small. I believe this acid to be the origin of that bitterness which I have so often observed on the hills; and even in the very brilliant water from the hills, the two processes have been going on at the same time—the formation of carbonic acid and the formation of the non-volatile acid.

Apparently there are times, perhaps flood-times, when the water does not become oxidised so much as usual; and then we find the bitterness as a result in a greater degree. Although I had observed this for many years, I had not known that the effects might be hurtful to those who drank the waters. I met this year, accidentally, at Oban, Professor Frankland, who told me of some gentlemen who had been very much inconvenienced and who actually took supplies of spring water with them to Inverness, at which place they had found the river to cause diarrhœa. I am not aware that this disease is more frequent at Inverness than elsewhere; but the water, or at least the substance in it, to which I allude, seems to be unwholesome to those who have not been accustomed to use it.

Chloride of calcium is observable in water from the clay slates of the west of Scotland, at least in some places. It is found also in Loch-Katrine water, although I have not seen it mentioned.

For some years I was inclined to believe that the bitter taste was owing to these salts, until I found it increased by oxidation. I am not prepared, however, to say that they are incapable of modifying the taste, although they exist in quantities very minute.

Taking this view of the case, water collected in the mountains is very different from that which has run down into the plains. The age of the water also is a matter of importance, and if kept long in deep reservoirs or in shallow reservoirs.

If in shallow reservoirs, the water may be uniform throughout; if in deep reservoirs, the oxygen may never be able to permeate to the bottom. At a depth of twenty feet I have found more than twice as much organic matter than was to be found on the surface, whilst the lower specimen was of a much deeper brown. This was in the Rivington reservoirs, as already said.

Water that comes down very rapidly may never be able, in a practical period, to have the organic matter thoroughly

* From vol. iv., 3rd series, of the *Memoirs of the Literary and Philosophical Society of Manchester*. (Communicated, with emendations and alterations, by the author).

oxidised. Water which purls down rather slowly, falling, nevertheless, over many rocks, is always clearer, although the reason partly of this is, that such water is not surface only, but has drained through the soil.

Peat itself, if distilled with fixed alkalies, gives out ammonia. I suppose there is no doubt that some of this arises from the decay of vegetable albumen, some of which may be retained in the peat; but its mode of decomposition is still a problem; it seems to take place chiefly by oxidation, not putrefaction. I was inclined to think that a notable amount of the ammonia might be taken by the acid waters direct from the atmosphere.

But the smoke of peat, or rather the oily matter deposited by the smoke, contains nitrogen compounds, very probably the bases obtained by the decomposition of that vegetable albumen, which will not enter into fermentation, or expand itself into the lower and dreaded organised forms, although compelled to yield to the action of fire. This shows that all the nitrogen does not exist as ammonia. Although Mulder is highly to be honoured for the work performed in endeavouring to elucidate the subject, and especially the question relating to *humus*, it is not easy to agree with him. If, however, any one would begin where he has left uncertainty some reward would be found.

I give a few quotations from Mulder's "Physiological Chemistry," first German edition:—

"I repeat that the ammonia in the soil, as in the natural saltpetre-grottos of Ceylon, is formed from the atmospheric air, the oxygen of which, instead of forming nitric acid, changes the organic substances into ulmic acid, then into humic acid, geic acid, apocrenic acid, and into crenic acid.

P. 158. "This formation of ammonia from the constituents of the air and water is of the highest importance for the growth and success of the plant. It is the cause which converts the insoluble organic constituents of the soil into soluble substances, and thus presents them to plants as organic food, even when no ammoniacal manures are added besides to convert the five mentioned acids into soluble salts of ammonia."

P. 166. "Ulmic, humic, and geic acids, however formed, possess the power of absorbing ammonia and water to the extent of several per cent. The quantity given out (at 140° C.) is between 8 and 16 per cent. It requires 195° to free them from water."

P. 167. "The power of ulmic, humic, and geic acids to condense ammonia is so strong, that the acid made by acting on sugar with hydrochloric acid almost always contains ammonia if air is not kept away."

P. 169. "These acids combine so intimately with ammonia, that they have the character of an organic compound of four elements; by treatment with potash at a higher temperature they lose the ammonia completely."

In the "Handwörterbuch der Chemie," under "Humus," it is said that by constant digestion with hydrochloric, acid, ammonia was not removed. It is also added that, boiled with an alkali, the ammonia is not removed.

This accounts for the opinion held by Berzelius and others, that nitrogen existed in these earth acids; and certainly it is not clearly shown that they are only ammoniacal salts.

Berzelius gives Hermann's old analysis of crenic acid as containing nitrogen; and until we can finally settle the composition of these substances, we may be allowed to doubt. Whatever the compound be which contains nitrogen, its disinclination to putrefy must lead us to believe that even the organic nitrogen is not a measure of the dangerous quality of water, whether that nitrogen exist in a non-putrescent condition or association of the albumen, or in a substance removed a step from albumen and passing downwards to a condition more allied to the idea of an inorganic body. My own belief is that part of the ammonia is in combination with earth acids, and part of that which we find is obtained by destroying an albuminous substance rendered non-putrescible by its surroundings.

I have given my reasons for believing that neither the nitrogen of ammonia nor the other nitrogen found in peaty water can be taken as the indication of the amount of putrescible matter. At present, I believe, we have no idea of the actual relation in which it stands to health. It will be interesting to know now if the nitrogen of the nitrates and nitrites is at all similar. These salts are not formed when putrefaction is going on rapidly. The reason is very simple: the water is then deprived of its oxygen. We do not know all the conditions of the formation of these salts; but one is essential, that oxygen shall be present.

In the Thames water, at least two miles below and above Hungerford, there was nitric acid in considerable abundance in 1848. It is mentioned, in evidence given in a parliamentary inquiry twenty years before that, that red fumes rose on heating the deposit. I quote from memory.

In 1848 this was certainly the case. In later analyses, by Dr. Hofmann, the nitric acid was not mentioned. I considered this at the time a mistake; and I examined the water again, finding, however, extremely little nitric acid, and, I believe, in some cases none.

Having examined other putrid streams, and found no nitric acid, I conclude that it had disappeared from the Thames also when it became more impure than previously.

During the time that river was so offensive near the Houses of Parliament, the organic matter must have wholly, or nearly deprived of its oxygen the air in solution. Running streams, however, do not, so far as I know, contain much nitric acid; that substance is formed in greatest quantity by the action of porous bodies. The oxidation is assisted by the pressure to which the gas is exposed by being brought in contact with a great amount of surface, as well as of numerous surfaces contributing to the result. For these reasons nitrates are found best in soils through which azotised matter in solution is slowly passed.

I had occasion to make experiments on this point, and showed, in a paper to the British Association, in 1848, that a filter might be made to form nitrates from putrid matter.

An interesting question arises—Does the nitric acid indicate the amount of organic matter which was previously in solution?

If nitrates are put on land, they are decomposed by vegetation, and the nitrogen is retained. These salts act both as food and air to plants. The water which flows from drained land may contain nitrates, but they are not a measure of the amount put on the land; and if they result from the organic matter there, they are still not in proportion to its amount, as, even after they are formed from vegetation, they may be decomposed by it.

Nitrogen, therefore, may be removed from water either as ammonia, or organic matter, or nitric acid, every trace of it finally disappearing. Those nitrates, however, which do remain indicate that at least an equivalent of albuminous matter or sewage matter did exist.

Another interesting question occurs—Is the nitric acid removed without vegetation? I believe that it is so.

In water from drained fields vegetation is generally found, though frequently in very small quantities. In the soil around drains it is found in considerable quantities; but after putrefaction has occurred in the Medlock, at Manchester, I have not found it. The oxygen seems to be removed as the oxygen of the air is, probably leaving nitrogen to pass off as gas.

As the nitric acid indicates an equivalent of albumen, I have put it down as telling us of the previous presence of organic matter; in other words, of old organic matter. The word "old" has no relation to time, except so far as to mean older than that from which the nitrites are formed, and the original organic matter. The nitrites,

not being fully oxidised, are supposed to be in the process of becoming nitrates. They have been taken, therefore, as indicating recent organic matter,—the word "recent" meaning only that they stand between the organic matter and the nitrates. I do not know that nitrates are converted into nitrites in water. Still it may be found to be so.

It may be asked,—If the nitrates are not a proof of albuminous matter, whence do they come? If it is said from the air, as Mulder would bring them, we need a proof; if from ancient remains, we need a proof; but we need no proof that they can come from albuminous substances. I believe they come from both animal and vegetable matter, so that decomposing roots and plants will send out some; but animal matter is the richest source. We have animal sewage and vegetable sewage. The latter is capable, as is well known, of doing much evil—perhaps not so much as the former, although this is uncertain. It does not seem proved that grass itself will not give nitrates. Yeast produces them. If vegetable and animal albumen are equally bad, we need not care as to the distinction of source; if nearly equal, we may care but little.

In looking for organic matter, I think it quite unsafe to trust either to chemistry or the microscope, without giving time for the development of all possible germs; but this is a point which demands a good deal of inquiry. Microscopists have given us details of appearances; but these have not been sufficiently classed; and the conclusions drawn have, therefore, not been valuable to the desired extent. To trust to the microscope without time for development, is to believe that the germs of disease can be seen. The use of allowing water to stand is not that the germs of disease may be seen, as we do not know them if we see them, but to see if the matter is active. The value of this must be tested.

The loss of the oxygen with peaty matter and no vegetation indicates, as already said, the formation of carbonic or a bitter acid. The loss of oxygen with the evolution of sulphuretted hydrogen indicates putrefaction; but there are two conditions which externally resemble each other very much, namely, the growth of vegetable matter with diminished oxygen, and the growth of vegetable matter with excess of oxygen. Water in the first of these conditions, too, may contain, as I imagine, the most dangerous ingredients: germs of all diseases may exist in such waters; we do not know to what extent; and, as we are very ignorant on the subject, it is well to be alarmed at the conditions, until we have examined them and made distinctions.

We do not know very much about the second of the two; and if I think it less dangerous, it is perhaps more from a prejudice in favour of the abundance of vital air, and of those hill-waters which do not contain bitter peat than from any accurate knowledge which has been attained.

Weighing the Organic Matter.

If nothing apparently organic is seen, or if there be no time to allow it to germinate, we may try the following method. About half a gallon of water is boiled down in a platinum vessel; or if there are no soluble carbonates it may be boiled in porcelain and transferred with care, when only a few ounces are left, to a platinum or even to a small porcelain capsule. The residue is dried and weighed. It is then burnt so as to oxidise the carbon, and weighed again; the difference gives the organic and volatile matter of the residue. 212° F., or 100° C., is not sufficient to remove all water; but as it is a temperature so easily obtained, it is convenient to consider it enough, especially as we cannot obtain the organic matter by weighing with absolute exactness. We may obtain an excess of water by the use of 212°, on one side; but, again, organic matter begins to be given off from some residues even at that temperature; Professor Miller and others advise about 300° F. It is, at any rate, well to state the temperature in the account of the analysis. Both temperatures appear to me wrong, and so is every other I can think of. The results, however, of this method are very useful.

The burning must not be effected at a very high heat, or several salts will be decomposed or evaporated; but at best some will suffer; and the use of a little carbonic acid and water, or carbonate of ammonia, to restore the lost amount is advisable. A little distilled water and a few expirations into it through a glass tube will be sufficient for most cases; of course after this the ash must be heated again.

Professor Miller advises the addition of 0·3 gramme of carbonate of soda to a litre of water, or 20 to 25 grains to a gallon, making allowances in the weighing.

It is needless to remark that I consider Frankland's mode of obtaining carbon and nitrogen far superior to any weighing, when hands sufficiently delicate are found. By using larger quantities, there seems no reason for supposing that the process cannot be undertaken by men who cannot advance beyond average refinement of touch. Since this paper was read, about a year and a half ago, the Wanklyn process for nitrogen has been gaining favour in my laboratory, as the results obtained have been very constant.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Meeting held at the Royal Institution, June 17th, 1869.

Dr. A. W. Williamson, F.R.S., President, in the Chair.

The minutes of the previous meeting were read and confirmed, and the following certificates read:—

For the first time—E. A. Blackwell, Analytical and Consulting Chemist, 6, St. Sacrament Street, Montreal, Canada.

For the second time—John Morrison, Analytical Chemist, County Wicklow, Ireland; W. G. Lewis, Fellow of Oriel College, Oxford; Alfred Dudley Keightley, Gatcheck Gunpowder Mills, Old Hall, Milnthorpe, Westmoreland.

The President then addressed the meeting as follows:—

The Society is here assembled to inaugurate what would be inadequately described as a monument in honour of Faraday. The Faraday Lectureship has been founded by the Council of the Chemical Society in the hope that it will promote the advancement of human knowledge, and surely no higher tribute of respect could be paid to a great man than to do in his name what he would have loved best to see done. Now, among the arrangements which are made for the promotion of interchange of ideas—ideas which are so essential to those who are working in the investigation of nature—there is one particularly important defect and shortcoming. We have books and papers which circulate throughout the length and breadth of the civilised world, and in each country there are Societies where men meet together to consider and discuss questions relating to science, and to aid and encourage one another in various ways. But these books and papers give but the skeleton of a science without that life and interest which is imparted to facts when communicated by a discoverer himself. And, on the other hand, Societies, although they do much for the promotion of science, leave still more undone. It is an essential of truly philosophical work that questions be viewed from various sides; and those who have followed with any attention the recent history of our young science, must have been struck with the variety of lines of thought followed simultaneously by independent workers—lines of

thought which finally converge in certain general truths; their convergence serving to corroborate the evidence of those truths, and to establish more perfectly the conclusions which are thus arrived at. Now, the greatest difficulty which is experienced, and the greatest defect which one observes, is this, that workers in one line of thought are too frequently ignorant, or insufficiently cognizant of what others are doing; and the defect shows itself chiefly between those who are working in different countries, more than between those who are working in the same country. Now, imagine that we could induce to come among us a man possessed of one of those master minds which forms a focus of light throughout science, and amongst all those who are interested in science: suppose that he were to tell us the thoughts which are uppermost in his own mind, and—best of all—that he were to make us for a time think with him in the very words of his own language: imagine that such a highly gifted man combined in his own person the genius of a discoverer, the breadth of intellect of a philosopher, and the lucid fluency of an orator. I am sure that you would agree with me, that his visit would inaugurate something which Faraday would truly have rejoiced to see. Imagine, I say, those things: accurately fix in your mind's eye the image of such a man—and Dumas is before you! [Loud applause.]

M. Dumas, La Société vous reçoit comme le plus illustre representant du progrès de notre science. Nous sommes heureux et fier de vous avoir parmi nous,—heureux de vous voir et de vous entendre, fier de ce que vous êtes venu au nom de Faraday. Je vous presente cette medaille qui a été frappée en commemoration de votre visite, et je vous prie de conserver avec elle le souvenir de cette réunion.

M. Dumas's lecture* commenced with a brief *éloge* of his friend, the late Professor Faraday. The Lecturer then, with admirable eloquence, passed to the consideration, first, of what he termed "*la matière brute*," and of its forces; and, secondly, of organic matter and the forces special to it. He traced the origin of some of the more important modern chemical doctrines to the labours of the Greek philosophers, and identified the principle of the ancient classification into fire, air, earth, and water, with that of Lavoisier's chemical elements. He acknowledged his great admiration of the labours of Dalton and Prout, and in a most lucid manner pointed out relations between the atomic weights of the now received elements which led him to infer the probability of many of them having a common basis. The audience was reminded that many years ago M. Dumas had contended that organic bodies are constituted in a manner similar to mineral bodies, and he took occasion to show how the progress of chemical research had confirmed the truth of this view, he himself being disposed to limit the term "organic substance" to those very few compounds which take part in the growth of organised beings.

Professor Tyndall then spoke as follows:—Fellows of the Chemical Society, Ladies, and Gentlemen—It becomes my duty to ask you to return your best thanks to M. Dumas for the noble discourse which you have just heard; and I sincerely thank the President of our Society for giving me this opportunity of testifying to the respect and high regard which I personally entertain for our first Faraday lecturer, both as a man and as a philosopher. [Applause.] It is now, Sir, [turning to M. Dumas] one and twenty years since, in company with the gentleman who now sits at my side, I first heard your voice. It was in your own *College de France*, and to this hour I have not forgotten the impression that you then made upon me with regard to your clearness, your power, and your eloquence as an expositor of scientific truth. You then, Sir, were celebrated as an investigator, and, as I thought, you were in the very blossom of your strength; but, Sir, I was wrong. You have this night shown a vigour and a depth and a capability of grappling with great questions, such as I doubt whether you possessed in equal vigour twenty-one years ago. You have to-night, Sir, grappled with some of the weightiest questions which underlie both chemistry and physics, and which constitute, if I might be allowed the term, the very solder of the material universe; and you have, moreover, vindicated the claims of science to a higher recognition than that which may be fairly based upon the material results that flow from it. You have shown how it can connect itself with philosophy, and with the general culture of the human mind. Sir, the walls which here surround you are associated with immortal memories. For more than sixty years they have been accustomed to hear voices which have gone forth into all lands. They have heard the voice of the great Thomas Young, of Humphry Davy, and of Michael Faraday; and we, Sir, bid you welcome to the scene of their teachings and of their triumphs. [Loud applause.] We, Sir, wish with all heartiness that you may long preserve the vigour which you have here displayed to-night, employing it as you have just done, for the delight of your hearers, the honour of science, and the good of mankind. [Applause.]

Professor Odling: I feel it a great privilege, and at the same time a great difficulty, after the eloquent remarks of Dr. Tyndall, to second the vote of thanks to M. Dumas, which he has proposed. As an old officer of the Chemical Society I may say we all felt that we could not find a more fitting or more able inaugurator of the Faraday lectureship than M. Dumas; but we also found that we could not find anyone more willing—I might say more desirous—to make the sacrifice of time and convenience that was demanded of him in order to do honour to the memory of that great man whose name we are this night met to commemorate. I think, however, that our vote of thanks to M. Dumas for his eloquent address, and for his coming over among us to deliver it, must not be lessened by the consideration that it was impossible for him to surprise us, or at any rate those of us who know him, by any display of eloquence and any display of kindness, however extreme. I call upon you then, with every mark of enthusiasm, once more to show M. Dumas how much you appreciate his kindness in coming among us, and how much you feel the honour of his presence, and the benefit to be derived from his most eloquent address. [Loud and prolonged applause.]

The President: It is unnecessary to put the motion for it has been carried by acclamation.

M. Dumas replied in a short but eloquent speech, and the President announced that another meeting of the Society would take place at Burlington House, on the 1st of July, when papers will be read by Mr. R. H. Smith and Dr. Phipson.

* We have purposely given only a short notice of Professor Dumas's oration, as a verbatim report will appear in our next number.

CHEMICAL SOCIETY DINNER

On the occasion of the Inaugural Faraday Lecture by M. Dumas, June 18th, 1869.

In another part of this number we have given an account of the magnificent lecture by M. Dumas. We have here the pleasing duty of giving a brief account of the banquet given to the eminent philosopher and chemist on the evening after the delivery of his inaugural Faraday discourse. As may be supposed, there was a large attendance of Fellows of the Society, all of whom were anxious to do honour to the memory of Faraday, and also to show their esteem and admiration for one who was a personal friend of Faraday, and who occupies one of the highest p laces amongst our continental scientists, The chair was occupied by the President of the Chemical Society, Dr. A. W. Williamson, F.R.S. The following is the list of stewards:—F. A. Abel, F.R.S.; T. Andrews, M.D., F.R.S.; E. Atkinson; J. Attfield, Ph.D.; J. Lowthian Bell; J. H.

Brazier; Sir Benjamin C. Brodie, Bart., F.R.S.; A. Bernays, Ph.D.; D. Campbell; F. C. Calvert, Ph.D.,F.R.S.; E. T. Chapman; A. H. Church, M.A.; F. Claudet; W. Crookes, F.R.S.; H. Debus, Ph.D., F.R.S.; Warren De la Rue, Ph.D., F.R.S.; F. Field, F.R.S.; G. Cary Foster, F.R.S.; R. Galloway; J. P. Gassiot, F.R.S.; J. H. Gilbert, Ph.D., F.R.S.; J. H. Gladstone, Ph.D., F.R.S.; T. Graham, D.C.L., F.R.S; G. Griffith; F. Guthrie, Ph.D.; A. V. Harcourt, F.R.S.; D. Hanbury, F.R.S.; C. Heisch; F. C. Hills; T. H. Hills; Dr. Holzmann; Sir Robert Kane, M.D., F.R.S.; J. B. Lawes, Ph.D., F.R.S.; G. D. Longstaff, M.D; A. Matthiessen, Ph.D., F.R.S.; J. Mason; H. Medlock; W. A. Miller, M.D., LL.D., V.P.R.S.; T. Morson, jun.; H. Müller, Ph.D., F.R.S; S. Muspratt, Ph.D.; E. C. Nicholson; H. M. Noad, Ph.D., F.R.S.; W. Odling, F.R.S.; J. D. Perrins; W. H. Perkin, F.R.S; Lyon Playfair, C.B., M.P., Ph.D., F.R.S; D. Price, Ph.D.; E. Ronalds; E. Schunck, Ph,D., F.R.S.; E. Schweitzer; P. Spence; R. Angus Smith, Ph.D., F.R.S.; J. D. Smith; J. Stenhouse, LL.D., F.R.S; A. Smee, F.R.S.; A. Smee, jun.; J. C. Stevenson; C. Tomlinson, F.R.S.; J. L. Thudichum, Ph.D.; R. V. Tuson; J. Tyndall, LL.D., F.R.S.; J. A. Voelcker, Ph.D.; P. J. Worsley; G. F. Wilson; J. Williams; Col. P. Yorke, F.R.S. After the usual loyal toasts, the Chairman eloquently proposed the toast of the evening, "The Health of Professor Dumas," and spoke of his high scientific skill and attainments in terms which were enthusiastically received by the company; and the health of the guest was drunk with the usual honours and amidst tremendous applause. M. Dumas replied in a fluent and brilliant speech, in which he alluded with great pathos and feeling to Faraday, and also spoke of the pleasure it gave him to accede to the invitation of the President and Council to deliver the inaugural Faraday Lecture. Several other toasts followed, which were appropriately acknowledged, and the speeches were interspersed with a selection of music performed by the band of the Coldstream Guards. The arrangements were exceedingly good, and the way in which they were carried out reflects great credit on the executive committee. The evening was a most agreeable one to all present, and we hope that M. Dumas will long remember the delight and enthusiasm with which he was welcomed to the scene of Faraday's labours. We are certain that the Society will never lose the remembrance of his grand and stirring oration, which will always be associated with the courtesy and kindliness displayed by the Master of the French Mint during his short visit amongst us. It only remains for us to hope that for many years we may gain as much pleasure and profit from the Faraday Lectures as we have from this—the inauguration of our memorial to England's great philosopher.

PROPOSED MEMORIAL TO FARADAY.

On Monday last, a public meeting was held in the theatre of the Royal Institution, Albemarle Street, for the purpose of considering what measures shall be taken for the promotion of a memorial to Professor Faraday, whose voice was so often heard as a lecturer within those very walls. The chair was taken at half-past three by his Royal Highness the Prince of Wales, who was supported by M. Dumas, Count Strelecki, General Sabine (the President of the Royal Society), Sir Henry Holland (President of the Royal Institution), Sir Roderick Murchison (President of the Royal Geographical Society), Sir Charles Wheatstone, Professor Williamson, Admiral Manners, Colonel Yorke, Professor Frankland, Mr. De la Rue, Mr. Frederick Pollock, Dr. Gladstone, Mr. Cæsar Hawkins, Dr. Holtzmann, Dr. H. Bence Jones (Secretary to the Committee), Dr. Lyon Playfair, M.P., Professor Tyndall, Professor Graham (the Master of the Mint), Sir John Lubbock, Sir Benjamin Brodie, Mr. Gassiot, Professor Miller, and a number of other distinguished personages, both English and foreign. The Astronomer Royal, Sir John Herschel, the Marquis of Salisbury, Mr. Layard, and other gentlemen who had been expected, sent letters to apologise for their absence.

The proceedings were opened by His Royal Highness, who, in a few well-chosen words, expressed the pleasure which it gave him, both on public and on private grounds, to preside over such a meeting as the present, and reminded his hearers that, although he whom they had met together to commemorate had been dead for nearly two years, yet nothing had been done by the public as yet to perpetuate his memory. Early in 1868, the Council of the Royal Society requested the President to take measures for the holding of a meeting to promote a monument to Faraday, and, with that view, the Secretary was instructed to write to the presidents of the following societies:—The Royal Society, the Geographical, the Linnæan, the Geological, the Royal Astronomical Society, and the British Association. On the 24th of March, a meeting of the presidents was held, and it was thought desirable, before proceeding further, to learn the views of Her Majesty's Government as to the erection of a monument as a recognition of his pre-eminent services to science and mankind. On the 22nd of June, Mr. Disraeli desired his secretary to say that he considered a monument to Faraday a proper object; but he suggested that its consideration should be left till next year. In the present year, the present Chancellor of the Exchequer wrote saying that he had no doubt of the signal merits of Faraday, and he thought that a monument ought to be erected; but he could not consent to devote public money to a monument for a private citizen, however illustrious. He did not make this rule; he found it. On the 8th of June, it was resolved to hold a public meeting at the Royal Institution. Under these circumstances, the Council of the Royal Society, and the presidents of the various other learned societies, had resolved to take the matter seriously in hand without further loss of time, and the result was the present meeting, at which it gave him the greatest pleasure to take the chair.

The first resolution—"That it is desirable that measures should be taken to provide a public memorial to the late Professor Faraday"—was proposed in a short speech by General Sabine, who said that the Royal Society, over which he had the honour to preside, felt a pride and a pleasure in reckoning Michael Faraday as one of its members, and bore his testimony to the fact that, out of all its long list of Fellows, none had contributed such a valuable collection of papers to the *Philosophical Transactions*.

This resolution was seconded by M. Dumas, Senator, Member of the Academy of France, and Permanent Secretary of the French Institute. M. Dumas began by reminding his audience that Faraday, whose genius achieved so much in the cause of science, and, therefore, of civilisation generally, was one of the eight Foreign Associates of the Academy of Sciences of the Institute of France. He also said that it was with pleasure he himself had crossed the Channel to do homage to his memory, and that it was with a feeling of profound emotion that he now found himself standing in the place where his late great contemporary had stood so often. M. Dumas declared that in France Faraday commands as many admirers as in England, and that among these admirers the Emperor of the French stands foremost—so much so, indeed, that his Imperial Majesty never loses an opportunity of evincing his regard for the name of the great *savant*, after whom Paris had named a street, and whose discoveries have not only done honour to England, but have been of incalculable service to the interests of the world at large. M. Dumas then proceeded with great eloquence and perspicuity to touch in detail upon some of the scientific achievements of Faraday, and took occasion to observe that his genius, in its various applications of science to practical purposes, was distinguished by originality, not less than by profundity, instancing his condensation of gas into liquids, his manufacture of steel

and of glass, his magneto-electric currents which encircle the world in the telegraph wires, and his magneto-electric light, to be seen in the most important lighthouses of England and of France. M. Dumas wound up his speech by expressing, in a tone of deep emotion, his own personal regard for a man who was singularly distinguished by his virtues in private life. There were many present who sympathised with M. Dumas when he added that the world at large had cause to lament the loss of Faraday as one of the greatest philosophers who ever shed light upon it by the force of genius, but that he himself had still greater cause to lament in his death the loss of a friend.

Sir Henry Holland moved the second resolution,—"That the following gentlemen be a committee to take the necessary measures for the provision of the said public memorial in honour of Faraday: General Sabine, President of the Royal Society; Sir Henry Holland, President of the Royal Institution; Sir Roderick Murchison, President of the Geographical Society; Dr. Williamson, President of the Chemical Society; Mr. George Bentham, President of the Linnean Society; Mr. T. H. Huxley, President of the Geological Society; Admiral Manners, President of the Astronomical Society; Dr. W. J. Hooker, President of the British Association; the Right Hon. A. H. Layard, M.P., Mr. J. Fergusson, Mr. Gassiot, Dr. Tyndall, Mr. Grove, Dr. Frankland, Mr. De la Rue, and Dr. Bence Jones, with power to add to their number."

The resolution was seconded by Sir Roderick Murchison, who referred to the fact that in that very theatre, more than 60 years ago, he had seen Sir Humphry Davy make some of those experiments in electricity which now formed the basis of modern science; and that, standing on the very spot where the Prince now sat, Faraday year after year had carried on those experiments after his master's death, training two successive generations of disciples in the study of the laws of nature. He bore willing and grateful testimony to the extreme modesty and humility of the great man who for more than half a century had made that institution his home, and adverted to the fact that Faraday had first shown marks of his high genius within the walls of the Institution in the year 1823, when, Mr. Brande being taken ill and unable to lecture, the duty of lecturing suddenly devolved on his assistant, whose simplicity, sincerity, and genuineness of character even then had begun to make themselves felt, and were but an augury of his after life.

Professor Owen moved the third resolution, to the effect "That a subscription, not exceeding five guineas in amount from any one person, be made for the provision of a public memorial to Faraday." He prefaced this resolution by a few remarks, to the effect that the theatre in which they were assembled was redolent of Faraday and seemed haunted by his spirit. Great and deep as was the learning which he displayed as a lecturer, still his profound and subtle generalisations were almost exceeded by that playfulness of wit by which he raised the intelligence of his hearers without lowering himself from the height of his professional dignity. Of his genius they had heard already from M. Dumas; but enough could scarcely be said of his personal merits, his singular modesty, and that unconsciousness of genius which is so often combined with genius of the highest order, as in Wellington. Like him, Faraday sought no honours, and all that he gained came to him unsought; but Englishmen feel that they all have a share in the achievements of both, and the reputation of the great philosopher, like that of the great warrior, is reflected on all his countrymen. Those, therefore, who are devoted to science have a right to call upon not only men of science, but Englishmen in general, to acknowledge and to pay the debt which we owe to Faraday. Let us think what will be the feelings of a future generation who will look back to him as we look back to Newton. His discoveries of the grand secrets of nature have added to our stores of wealth and ministered to our comforts, and hereafter there will arise the feeling that we have not done as much as we ought for one who has done much for us. He then urged that Faraday and the Royal Institution were standing proofs of the results which could arise out of the voluntary system as opposed to State establishments. Faraday served a voluntary body—a "joint-stock company founded for the purpose of diffusing intellectual pleasure," and this body whom he served gave him a home in which he might carry out his experiments in the field of science. Late in life had come a public recognition of his services in the shape of a pension and a house at Hampton Court—the latter a free gift for life from his Sovereign. He observed that, as the introduction of the electric telegraph and gas had added to the conveniences and comforts of life, and had helped to diminish crime, the discoverers of such secrets of nature at the very least deserved some reward at the hands of those to whom they ministered—if not from the nation in its collective capacity, at least from its individual members; and he concluded his speech by remarking that, if any member of either House of Parliament should chance to be present there, he ought to take note of the right relations of the nation to men of science.

The resolution was seconded in a few brief but telling sentences by Dr. Lyon Playfair, M.P.

The three resolutions were severally put to the meeting by his Royal Highness, and declared to be carried unanimously.

A vote of thanks to the Prince for his kindness in presiding over the meeting and for his conduct in the chair was proposed by Sir Henry Holland and seconded by Professor Tyndall, who spoke with great feeling of the loss which both himself and the nation had sustained in the death of Faraday, and alluded to the fact that on that occasion the Prince had been among the first to write to condole with his widow. The motion was carried with great applause.

Dr. Bence Jones then read a letter from Sir John Herschel, excusing his absence on the ground of illness; it ran as follows:—

"I grieve to say that I can only be present in spirit at the meeting of next Monday, the state of my health being such as to preclude my leaving home for many months, most anxious though I should naturally be to show every possible reverence and honour to the memory of such a man as Faraday, whom I have always regarded as the "blameless prophet" of British science—so clear and far-reaching was he in his views, so indefatigable in their pursuit, so single in his objects, so blameless in his life, so genuine, candid, and unaggressive in all his relations with his brother *savans*."

The Prince briefly acknowledged the vote of thanks, and assured the meeting that he should be proud to lend his aid to the cause which they had met to promote, and it was announced that subscriptions to the "Faraday Memorial Fund" might be paid in at the Bank of England, Western Branch, Burlington-gardens; the London and Westminster Bank, St. James's-square; to Mr. William Hughes, at the Royal Institution, Albemarle Street; or to any members of the committee.

LABORATORY NOTES.

BLOWPIPE REACTION OF THALLIUM.

When either oxide of thallium is melted with borax, it gives a clear, colourless bead; but when this is kept for some time at a heat much below redness, the outside turns deep brown, owing to the formation of thallic oxide. On raising the temperature, it is again reduced to thallous oxide, small bubbles of oxygen are set free, and the bead again becomes colourless. I am not aware that any other substance behaves in the same manner.

H. C. Sorby.

CORRESPONDENCE.

ARTIFICIAL MANURES:

A COMMON SENSE VIEW OF THE PRECIPITATED PHOSHATE QUESTION.

To the Editor of the Chemical News.

Sir,—I have perused Mr. Hughes's paper with some interest, but more of astonishment. Is it or is it not the fact, that the greater part of the soluble phosphate of lime supplied to the soil in superphosphates is very speedily converted into precipitated or reduced phosphates, *i.e.*, insoluble in cold water? If it be a fact (and Mr. Hughes will hardly dispute it), why does he ask the manufacturer to make the farmer a present of some 3 to 6 per cent of valuable phosphates, for all intents and purposes of agriculture equal to soluble phosphates? Doubtless, Mr. Hughes is a very good chemist; but, in his zeal in combating the unfair use of oxalate of ammonia as a solvent for *reduced* soluble phosphates, he has rushed off to the other extreme. In his hot haste, and fresh from his "half-hours" of stewing coprolites, first with half their weight, and then with double their weight of oxalate, he rashly seeks to *rob* the manufacturer of his hardly-earned soluble phosphates! and, no doubt, the next farmers' club that sends a set of samples to Mr. Hughes for analysis will get them analysed on this principle. Nearly all superphosphates in good condition, from having lain long in the pile, contain more or less of this reduced soluble phosphate. Will Mr. Hughes or Dr. Voelcker contend that, because Mr. Chesshire has used a faulty process (if it be so), and, by boiling for half-an-hour, may have obtained more soluble phosphate from his samples than their respective bulks contained, that therefore the manufacturers are to be fined half-a-crown (or some such sum) per ton for every unit of soluble phosphate which has become reduced in the pile? This is a matter of very serious importance to manufacturers, and one which it behoves chemists, and especially so-called agricultural chemists, to settle.

May I venture to suggest that, if Mr. Hughes will abjure hot water in his examinations for soluble phosphates, he will get more correct results, and, if he had used a cold and very dilute solution of the oxalate, his experiments would then have been of more value. Again—for his own satisfaction, and by way of testing this matter—will Mr. Hughes perform an analysis of the clear solution obtained by pouring distilled water on to superphosphate on a filter; and then let him take another portion of this solution, and *reduce* the whole of the soluble phosphate by precipitating it with ammonia or lime-water. He will then have some precipitated phosphates on which to operate, and, if he will send you his results, I doubt not they will be of some practical value. He will then be able to say the minimum of oxalate of ammonia required to re-dissolve this phosphate, which he now wishes the manufacturer to give to the farmer for next to nothing.—I am, &c.,

Fair Play.

London, June 14th, 1869.

MISCELLANEOUS.

Death of M. Bérard.—We learn from the *Messager du Midi*, a daily paper published at Montpellier, that M. J. E. Bérard died in that city on the 10th inst., at the advanced age of nearly 80 years. The deceased, a celebrated chemist, was born at Montpellier on the 12th of October, 1789. He was first Professor of Chemistry of the Faculty of Sciences at Montpellier, and held simultaneously the Professorship of Chemistry of the Ecole de Pharmacie established in that city. For about the last twenty-five years he has been, first the active, afterwards honorary, Dean of the celebrated Faculty of Medicine of the University of Montpellier—a post of honour and influence—and he has been well known in various scientific circles. He was a member of several learned societies, the owner of large chemical works, and a man of independent means—a very courteous, but yet somewhat haughty, scientific diplomatist; he was a staunch upholder of the rights of the Université de France, and, at the same time, in politics a constitutional liberal. Those who have been personally acquainted with him, like the writer of these few lines, can testify that he was an eloquent and highly accomplished lecturer, an eminently successful experimenter, kind and forbearing with the students of his class, who, on an average, numbered from 1100 to 1800.

London Institution.—We have received the report of the above Institution, from which we find that it is proposed to adapt the chemical resources of the Institution to the practical teaching of chemistry. The following is an abstract of Professor Wanklyn's "Laboratory Report for the Session 1868-9":—"In addition to the annexed list of papers [a list of eleven papers follows, abstracts of which have appeared in our columns] from the Laboratory, it should be mentioned that a very elaborate memoir on the alcohols of fermentation, by my friends Messrs. Chapman and Smith, has been laid before a recent meeting of the Chemical Society, and is in course of publication in the "Journal." Much of the recent investigation has consisted in an elaborate confirmation of M. Wurtz's results—a circumstance which is not unimportant, regard being had to the great improvements in method which have been introduced since the date of M. Wurtz's investigation of butylic alcohol. The recent discovery of isomeric forms of the alcohols, and the exceedingly interesting structural differences presented by these isomers, give additional value to a careful study of a natural alcohol, such as butylic alcohol. The Royal Society has testified its approval of investigations such as this by making a grant of £50 to Mr. Chapman for the prosecution of researches of this character. In the paper entitled "*Researches on the Ethers*," read at the meeting of the British Association in Norwich, there is recorded a work in contradiction of a very important set of results published by eminent English chemists a few years ago. The result contradicted is, that an acetic acid had been produced in which part of the *radicular* hydrogen had been replaced by the metal sodium, so as to yield sod-acetic acid, or, more correctly, sod-acetic ether. It has been shown that, contrary to the assertion of two English chemists, there is no driving out of hydrogen by the action of sodium on acetic ether. As a consequence of the disproof of the elimination of hydrogen, a huge superstructure of unsound chemical theory has been destroyed. In conclusion, I would just call attention to the very interesting set of compounds—the salts of the new organo-metal, ethylene-sodium—which have been recently discovered in the laboratory of the Institution, and which are being investigated at the present moment."

Quantity of Water contained in Illuminating Gas.—During the months of February and March of the current year, the author (A. Vogel) instituted on various days, and at different hours during the day and night, experiments with the gas taken directly from the mains of the Münich Gas Works. By causing a slow current of the gas to pass through chloride of calcium tubes, the author found that the quantity of water contained in the gas varied from 0·06 to 0·11 grm. to the cubic foot; it is evident that this quantity may, and naturally will, vary according to circumstances. Dr. Vogel next made a current of gas pass through glass tubes placed in a freezing mixture; in this manner he obtained a quantity of ice formed by the freezing of the water contained in the gas; the water obtained on melting this ice had no action upon test papers. By means of Nessler's test, after previous addition of some caustic potassa to the water, ammonia was very clearly indicated to be present. Cyanogen was found therein by means of Schönbein's test-paper for this substance. When tested with indigo-carmine and sulphuric acid, the decolouration of indigo is observed, while an odour of nitrobenzol is emitted. It hence appears that there is nitrate of ammonia present, and that this is one of the products of the distillation of coal.—*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*

Testing Bees'-Wax.—It appears that both yellow and white bees'-wax is met with in the trade largely adulterated with paraffin. In order to detect this, the following process is recommended:—2 grms. of the wax to be experimented upon are placed in a test-tube; and there is added a solution, consisting of 1·5 grms. of solid caustic potassa in about 5 grms. of distilled water, and the mixture boiled, care being taken to shake the test-tube now and then, whereby a thorough though not quite clear mixture is produced. When the fluid has cooled so far down as nearly to reach the point of solidification of the wax, from 6 to 8 grms. of light oil of petroleum is gradually added, and this thoroughly incorporated with the entire mass, so as to form an emulsion, from which, if well made, the light oil does not separate. Next, an excess of an aqueous solution of acetate of lead is added, which is mixed with the mass by stirring with a glass rod. The addition of this lead salt causes the separation of the light oil of petroleum, and in it will be dissolved any paraffin present in the wax. The same operation is twice repeated with the contents of the test-tube, that is to say, petroleum is again and again added, and allowed to separate; the separated petroleum is placed into a retort, and the light oil removed by distillation. Pure yellow wax loses, by this process, from 14 to 16 per cent; but wax has been met which lost 57 per cent in weight; the specific gravity of the residue of adulterated wax was 0·88. When it is desired to obtain the paraffin in pure state freed from any dissolved wax, this may be effected by cautiously decomposing the wax supposed to be adulterated with paraffin, by means of fuming sulphuric acid, which does not affect paraffin.

The Zirconia Light.—The oxygen process of M. Tessie du Mothay, according to the Paris correspondent of the *British Journal of Photography*, consists in heating, in iron retorts divided in two by a horizontal grating, a quantity of manganate of soda. This is heated to a dull red, and a current of superheated steam is made to pass over the mass. Oxygen is given off in abundance, and passes along with the current of steam into a refrigerator, where the steam is condensed into water, and the oxygen is afterwards collected in a gasometer.

When no more gas comes off, the manganate is exhausted. The next operation is to re-oxygenise the exhausted manganate. This is accomplished by passing heated *air*, not steam, over it, when the manganate absorbs the oxygen, and becomes as ready as ever for yielding it again to the vapour of water. Thus, the two operations can go on for an indefinite time, the air being the source of supply of oxygen. It has been found that carbonic acid gas is detrimental to the production of oxygen, and so the air is deprived of this before it acts upon the manganate of soda. One advantage claimed by the advocates of the zirconia cylinders, besides their durability, is that a mixture of *equal* parts of oxygen and carburetted hydrogen can be used instead of a mixture in which oxygen is in excess, as is usual. The magnesia for the magnesian cylinders must be very pure, and free from silica, or they will not be durable under heat.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we are endeavouring to effect arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

Comptes Rendus des Séances de l'Académie des Sciences, Monday, June 14, 1869 (No. 24).

This periodical is entirely filled with the reports about the prizes and the distribution thereof. The greater part of the speaking at this meeting of the Académie devolved upon the eminent and eloquent speaker who honoured the Chemical Society with his excellent speech on the night of Thursday (June 17) at the Royal Institution in London, M. Dumas; and his eminent *confrère* as Sécrétaire Perpétuel, M. Elie de Beaumont, read the eulogium on the late M. Puissant, an excellent geodesist and late member of the Académie. Among the prizes distributed we notice the Jecker prize, which has been granted to M. P. A. Favre for his researches on the heat set free by chemical combination; a sum of 2000 francs (£80) has been granted to M. A. Gautier for his researches on hydrocyanic acid, the nitriles, and a new class of substances isomeric therewith.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 196, April, 1869.

Omitting the papers on subjects connected with mechanics and engineering, we meet with a report—

On the New Method of Purifying Oils invented by M. Michaud, of Honfleur; the report is from the hand of M. A. Chevalier. After having reviewed the different processes in use from the middle of last century, to render fatty oils, such as rape-seed and colza oils, more suitable for use in lamps of a more complicated construction, the author of the report states that M. Michaud's process consists of a defecation of the raw oil, by the simultaneous introduction therein of jets of air and thin streams of sulphuric acid, whereby those substances contained in the raw oil, which are injurious to its properties for use in moderator and carcel lamps, are coagulated and brought to the surface of the oil as a scum, which can be easily removed; the oil is next washed with water, afterwards heated by steam to 100° C., and lastly filtered through cotton and a layer of clean and pulverised marble, at a temperature of 40° C., yielding an excellent material for use in lamps.

This number also contains a lengthy treatise—

On Electricity and its Application to the Construction of Electrical Apparatus for Medical Use.

And a lengthy treatise—

On the Cultivation of the Mushrooms known as Truffles.—To this paper are added analyses of twenty-four different kinds of soil taken from various parts of France, but it does not, after all, appear that there is distinct relation between any kind of soil and its capability of growing these dainties, which, as appears from this paper, were largely cultivated in France, for the use of the wealthy Romans, at the time Cicero and Horatius lived. Curiously enough, those parts of France—the native country *per excellentiam* of truffles—which produce good wine, do, as a rule, also produce these cryptogamics in excellent condition.

Annales du Génie Civil, No. 5, 1869.

This periodical contains the following short notices concerning matters of interest to our readers, in addition to its valuable papers relating to mechanical science:—

Artificial Ebony.—This material is prepared on the large scale in the following manner:—60 parts of charcoal, obtained from seaweeds, and previously treated with dilute sulphuric acid, and dried, are ground to powder, and mixed with 10 parts of liquid glue, 5 of gutta-percha, and 2½ of caoutchouc, care having been taken to mix the two latter substances with coal-tar oil, and thus to render them gelatinous; next 10 parts of coal tar, 5 of pulverised sulphur, 2 of pulverised alum, and 5 of powdered resin are added, and the mixture heated to 300° F. After having been cooled, a substance is obtained, which, in every respect, is equal to genuine ebony wood, but is far less expensive, and takes a finer polish.

Vulcanisation of Caoutchouc.—In a great many instances, especially when a superficial vulcanisation only is desired, bisulphide of carbon and chloride of sulphur only are applied. Since the bisulphide is very inflammable as well as very volatile, and is, beside this, injurious to the health of the workmen, it is desirable to desist from its application; instead of it, petroleum is now used, after having been submitted to a peculiar process of refining; it is for that purpose mixed with sulphuric acid, thoroughly stirred, and, after having been left quiet for some time, the supernatant oil is withdrawn by means of a syphon, and placed in distilling apparatus along with some caustic potassa, and submitted to distillation. The refined petroleum thus obtained is, however, a less good solvent for caoutchouc than the bisulphide of carbon, and hence the vulcanisation process may, by the use of petroleum, become less complete and less penetrating than by the use of the bisulphide of carbon.

Manufacture of Phosphorus.—M. Brison proposes to apply for this purpose, on the large scale, a furnace not unlike a blast furnace as used for the reduction of iron ore. Through a kind of throat or mouth, which can be hermetically closed, coke and phosphate of lime, either apatite, coprolites, or any other, are introduced, along with a sufficient quantity of a suitable flux to liquefy the lime of the phosphate and the ashes contained in the coke. A blast-pipe, connected with a blowing engine, introduces a sufficient supply of air to keep the coke, after having been ignited at a high temperature, while a tube, plunging into a tank, filled with cold water, is intended to carry off the vapours of phosphorus set free by the reducing action of the coke upon the phosphate; the slag is run off in a peculiar manner, somewhat akin to that in use with blast furnaces at iron works, but so as to prevent phosphorus escaping. According to a note by the editor of the paper at the head of this notice, the results obtained with this furnace are very satisfactory.

Les Mondes, June 3, 1869.

Newly-Invented Gunpowder.—A Bavarian chemist, named M. Hahn, has brought to Paris a proposal to sell his invention of a new kind of gunpowder, which, according to his statements, is so readily prepared, that one workman, while engaged for ten hours a day, can mix 200,000 kilos. (200 tons) of the materials the powder is to consist of, which are substances readily procurable in any country. This powder, on being ignited, gives off no smoke, and is neither affected by damp nor dryness, and can be safely stored anywhere. We refrain from quoting more about this subject, as we fear *le bon* Père Moigno has been taken in somewhat, as would appear from the statement that this powder, while floating on water, yet explodes in contact therewith, and is not after all affected by damp (*sic*).

Boiling of Sugar.—M. Woestyn.—The only noteworthy point in this rather practical paper is the observation, made by the author, that, notwithstanding the use of the vacuum pan, by the application of steam of 1, 2, 3, 4, or 5 atmospheres over and above the atmospheric pressure, and corresponding to temperatures of 100°, 122°, 134°, 143°, and 152° C., an increase of colouration, averaging 2, 4, 8, 12, and 16, is obtained, while, at the same time, research with the *saccharimètre optique* proves analogous quantities of inverted sugar in the product previous to the boiling free therefrom.

Among the books of which receipt is acknowledged we notice an Italian monograph, by M. A. Raffaelle Drago, which bears the title—"*Resumé* of the Theory of the Rev. Father Angelo Secchi, S.J., on the Relation existing between the Meteorological Phenomena and the Variations of Terrestrial Magnetism." This book is highly spoken of in the above-named periodical, which contains a lengthy paper, "On the Phosphorescence and Luminosity of Gases under Reduced Pressure," translated from the Official Gazette of the Kingdom of Italy, this paper, however, does not contain anything on this subject which is not already known to our readers.

June 10, 1869.

The only communication we briefly notice from this number is:—

Localities of Rock Salt.—Dr. A. Boué.—The author says: The ten or twelve large sites of rock salt at present known belong, in a geological sense, to either secondary or tertiary formations; those of the Devonian and Silurian deposits appear to have been formed by the evaporation of their existing seas, by the action of the heat of the interior of the globe. The saline deposits and beds of gypsum of triassic period are neither due to evaporation or sublimation, and appear to have been rather formed by saline waters, saturated solutions of salt, from springs, running into then existing seas, and causing such a supersaturation as to bring about a deposit of chlorides and sulphates. The saline springs, salt springs of the cretaceous period may be the result of fresh water which has become saturated with salt while traversing deeper lying beds thereof, and being afterwards forced up by hydrostatic pressure. It may be said that a continuous diminution of sea-water has been taking, and is yet actually taking place, from the first existence of a sea on our globe, either by chemical action, or by infiltration.

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1523. W. Benson, Hexham, Northumberland, "Improvements in treating or reducing ores, and in apparatus employed therein."—Petition recorded May 18, 1869.

1632. F. A. Barrow, Glasgow, N.B., "Improvements in purifying or bleaching mineral oils."—May 27, 1869.

1642. J. Brönner and H. Gulzkow, Frankfort-on-the-Maine, "An improved method of obtaining anthracen out of asphaltos—that is to say, pitch produced from coal-tar—and of preparing two colouring matters from the anthracen."

1652. A. T. Fairgrieve, West Street, Sunderland, "An improved paste or composition adapted for coating the bottoms of wood and iron ships."—May 28, 1869.

1668. P. Kirk, Workington, Cumberland, "Improvents in puddling furnaces, and in other furnaces employed in the manufacture of iron and steel."—May 31, 1869.

1691. H. Browning, Salmon Lane, Limehouse, Middlesex, "Improvements in compositions suitable for use as varnish or paint."—June 1, 1869.

1700. G. V. Turnbull, C. Salvesen, and R. Irvine, Leith, N.B., "Improvements in the manufacture or preparation of lubricants or softeners, and the application of the same to the treatment of hemp, jute, flax, and other like fibrous materials."

1706. H. Larkin, Torriano Cottages, Leighton Road, and W. White, Thurlow Road, Hampstead, Middlesex, "Improvements in the manufacture of magnesium, and in the preparation of its anhydrous chloride."

1710. A. L. Simpson, Stowmarket, Suffolk, "Improvements in compositions suitable for treating sheep attacked by fly, and for other similar purposes."—June 2, 1869.

NOTICES TO PROCEED.

318. W. J. Palmer and W. P. Goulding, Reading, Berkshire, "Improvements in evaporating and calcining alkaline solutions which have been used to boil vegetable fibres."—Petition recorded February 2, 1869.

362. J. Halford, Kingswinford, Staffordshire, "Improvements in puddling furnaces used in the manufacture of iron, and in other reverberatory furnaces."—February 5, 1869.

419. P. Taysen, Leith, "Improvements in the manufacture of stearic and oleic acids."—A communication from J. C. A. Bock, Copenhagen, Denmark.—February 10, 1869.

460. A. H. Lewis, Fenwick Street, Liverpool, "Improvements in extracting copper from its ores."—A communication from T. S. Hunt, Montreal, and J. Douglas, jun., Quebec, Canada.—February 15, 1859.

510. E. Dorsett, London Street, London, "Improvements in means and apparatus for heating, smelting, and working metals, and in furnaces employed therein, which improvements are also applicable to heating and otherwise operating upon minerals and other substances."—February 19, 1869.

699. J. P. Budd, Ystalyfera, near Swansea, Glamorganshire, "Improvements in the manufacture of iron and steel."—March 8, 1869.

727. G. Spencer, Cannon Street, London, and J. Barker, St. Leonards, Mortlake, Surrey, "Improvements in preserving animal substance, fruits, and other substances, made from corn, grain, or other vegetable matter."—March 9, 1869.

1044. W. T. Rickard, Crown Court, Threadneedle Street, London, "Improvements in the preparation of cements."—April 7, 1869.

1418. H. R. Lumley, St. John's Wood, London, "The treatment of molten iron in order to free it from all impurities."—May 10, 1869.

1568. G. Johnston, San Francisco, California, U.S.A., "Improvements in the distillation of spirituous liquors, and in apparatus to be employed therefor."—May 20, 1869.

NOTES AND QUERIES.

Superphosphates.—Probably some of your chemical correspondents would tell me if, in superphosphates, a chemist can say whether it has been made from bone material or mineral phosphate, either wholly or mixed. I am in the way of selling and buying such, and buy according to the quantity of soluble and insoluble phosphates present. I wish to buy nothing but bone material. According to Dr. Anderson and other agricultural chemists, the phosphates in mineral is of much less value than in bone this last season; the phosphate in mineral was sold at 10d. per unit per ton, while that in bone-ash was 1s. 5d. per unit per ton. I buy at the rate given for phosphates in bone-ash. I have sent to a number of chemists for analysis samples of my manure, and get often very irregular results from the same lot; but in no case can I be informed whether the manure has been made from bone-ash wholly, or only partly, and how much of the one and the other. Is this problem within the range of ordinary analysis? If not, what guarantee have farmers that they are not paying for an article they do not get.—A Constant Reader of The Chemical News.

Albumen.—It frequently happens that among the dried albumen met with in commerce a variety is met with which is soluble in water, but not coagulated by the application of heat. Dr. Monnier, at Lyons, has succeeded in preparing this modification, and has studied its properties. When white of eggs is slowly evaporated by exposure to the heat of the sun, or rapidly evaporated to dryness on a water bath, after having been previously exposed to strong daylight for a considerable length of time, a modification of albumen is obtained, non-coagulable by heat. A dilute aqueous solution of this non-coagulable albumen is not precipitated by addition of acetic, formic, or tartaric acid, but the addition of these acids (a few drops) restores its coagulability by heat. In order to restore to 0·20 grm. of this dry albumen dissolved in 10 c.c. of water its coagulability by heat, it was sufficient to add 5 milligrammes of solid crystalline acetic acid, dissolved in 0·5 c.c. of water. If as much ammonia was added as exactly suffices to neutralise the acid, the albumen thereby again lost its property of becoming coagulated by the application of heat.—*Deutsche Industrie Zeitung.*

Rendering Walls Impervious to Damp.—This is not a very simple question; well-built walls of proper construction ought not to be damp: the causes of dampness may be—(1) bad foundation in a wet or ill-drained soil too impervious for water, and the use of unsuitable building materials, *i.e.*, too porous bricks or natural stone; (2) walls may be damp because on being exposed to rain, and made of materials which greedily absorb and retain water, they slowly but surely allow it to evaporate where the heat is greatest, viz., on the inner side; (3) damp walls may be due to the infiltration of water from drains, as well as from improperly-constructed gutters along the roof, and rain-water pipes. Really sound building materials, well-seasoned stone and sound bricks, laid in a proper cement and upon a suitable foundation, concrete if necessary, and application of coal tar or even asphalt will insure against defects of soil wherein foundation is laid, especially if care be taken about proper drainage pipes. As to covering, coating rather, walls inside with materials to resist damp there are various means at hand. Supposing due care to have been taken in building the wall, and good materials to have been used, it may be coated with a thin layer of good Portland cement, mixed with a little plaster of Paris, and, after this is thoroughly dry, it may be hardened, and rendered impervious to water by painting it with boiled linseed oil and red-lead mixed together. If it is required afterwards to have a kind of stucco laid on, it not being intended to paper the wall, such stucco may be made up—(1) of gypsum, plaster of Paris mixed with a thin glue solution, to which a small quantity of sulphate of zinc has been added, constituting, after drying, a hard surface, which can be rubbed smooth with pumice-stone; (2) or a paint is used, made of 50 parts of fine white sand, similar to that used in glass-making, 50 parts of marl, 9 of massicot, litharge, and 9 of red-lead, mixed with 4½ quarts of boiled linseed oil. Water-glass, or silicates of soda or potassa, have not been found to answer well: perhaps Szerelmey's silicate zopissa might answer the purpose.

TO CORRESPONDENTS.

*** *In consequence of the enlargement of our journal by the introduction of abstracts of all the foreign periodicals, the index is much larger than it has hitherto been; we have therefore decided to issue next week a supplementary number, which will contain the title-page, preface, and a copious index to the present volume. The price will be the same as for an ordinary number. Unless advised to the contrary, that number will be forwarded to subscribers with the first number of the next volume, to be published on Friday next.*

A. B. E.—Our correspondent will find in No. 488, April 9, 1869, p. 178, the information he asks for.

Communications have been received from Robbins, Lane, and Pinniger; G. W. Buckley; R. Laurie; B. Nightingale; A. S. Herschel; W. Blench; Ritchie and Sons; J. H. Richardson; W. Wotherspoon; A. Wuth; J. Wallace; M. Prentice (with enclosure); H. Bassett; Maclachlan and Stewart; H. Greenwood; J. C. Major; J. Thorn (with enclosure); E. G. Tosh; T. Morson and Son; W. and H. M. Goulding (with enclosure); P. Squire; S. R. Muspratt; A. N. Graham; W. Bailey and Son; J. Cliff; J. Tilley; F. W. Whiffin; H. Cole, C.B.; R. Gregson; J. C. Brough; J. Barclay; J. Jones; Dr. Bedford; E. F. Teschemacher; and J. Denham Smith.

NEW WORK BY DR. W. ODLING, F.R.S.
Just published, in crown 8vo., Price 4s. 6d., cloth,

Six Lectures on the Chemical Changes of Carbon, delivered before a Juvenile Auditory at the Royal Institution of Great Britain. By William Odling, M.B., F.R.S., Fullerian Professor of Chemistry, Royal Institution. Reprinted from the Chemical News, with Notes by William Crookes, F.R.S., &c.

London: Longmans, Green, and Co., Paternoster Row.

Just published, demy 8vo., price 6d.

On English and Foreign Alkalimetrical and Chlorimetrical Degrees, by John Pattinson, F.C.S. Read before the Newcastle Chemical Society.

London: Chemical News Office, Boy Court, Ludgate Hill, E.C.

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VOLUME XX.

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No. 501.—FRIDAY, JULY 2, 1869.

THE FARADAY LECTURE,

DELIVERED BY

M. J. DUMAS,

Sénateur; Président de la Commission des Monnaies et Médailles; Member, and one of the Perpetual Secretaries, of the Institut; Inspecteur Général de l'Enseignement Supérieur; President de la Société d'Encouragement pour l'Industrie Nationale; Grand Croix de la Légion d'Honneur, &c., &c.

BEFORE THE

CHEMICAL SOCIETY OF LONDON,

IN THE

THEATRE OF THE ROYAL INSTITUTION,

THURSDAY, JUNE 17TH, 1869.

GENTLEMEN,—You have desired that the memory of Faraday should be handed down to posterity; you have summoned together men of science, all to celebrate, in a solemn manner, his great and beneficial labours; and, calling upon France to take the lead in this solemnity, you have chosen me to be his panegyrist, no doubt on account of the long and constant friendship with which I was honoured by Faraday.

I am the bearer of the acknowledgments of the scientific men of France, as well as my own. My country—I am proud to say it—can offer representatives of science much more worthy of your approbation; but I know no one, at least, who feels more intimately the sentiments of profound gratitude for the noble welcome which England has accorded for so long a time, nor do I know one who bears so sincere a veneration for Faraday.

The name of your illustrious fellow countryman is not one which any single nation can claim as its exclusive property; his labours and discoveries are as widely recognised in France, in Germany, and in America as in England. Faraday belongs to the whole world. There is not a spot on this earth to which civilisation has penetrated, that does not claim the right of partaking of the respect and gratitude you entertain for him.

Faraday was identified with the scientific movement of the first half of this century; he was one of its principal leaders, and drew in his train a whole host of thinkers, engineers, men of enterprise, and capitalists. Ever contemplating the chaste beauties of nature, and searching into her most hidden recesses, this disinterested philosopher, this deep thinker, scattered broadcast on his path the seeds of the most extraordinary and unheard-of results—such are the electric currents of Faraday that bear our messages, furrowing Europe and traversing the Atlantic—such are those lights, rivalling the sun in brilliancy, which shine forth from our principal lighthouses; and it is even to the gases which he liquefied that hot countries owe the luxury of ice.

In the pursuit of truth alone, he was able to satisfy, as if by accident, the boldest demand of a refined civilisation; and, devoted to the ideal, he sowed the seed of riches, not for himself, for he despised them, but for the profit of trade, which has gathered the fruit.

Faraday is the type of the most fortunate and most accomplished of the learned men of our age. His hand, in the execution of his conceptions, kept pace with his mind in designing them; he never wanted boldness when he undertook an experiment, never lacked resources to ensure success, and was full of discretion in interpreting results. His hardihood, which never halted when once he had undertaken a task, and his wariness, which felt its way carefully in adopting a received conclusion, will ever serve as models for the experimentalist.

The study of nature entirely puts aside conjecture, and places a guard on vague hypotheses; it begins with facts, ascends to laws, and raises itself, as far as the limits of man's intellect will permit, to the knowledge of causes, by the triple means of observation, experiment, and logical deduction. A long familiarity with the exact detail of phenomena can alone give to a man, as to Faraday, the right of being bold; he is, like Faraday, restrained when he has a thorough appreciation of the limits of man's knowledge. It is two centuries ago since Europe received this system of philosophy from Galileo and Newton, characterised at that epoch by the establishment of the Academy of Naturæ Curiosorum, in Germany, which represented the art of observation; in Italy, by the Academia del Cimento, the school of experimental science; and in England and France, by the Royal Society of London and by the Académie des Sciences de Paris, which adopted mathematical science as one of the means most conducive to the knowledge of truth in the domain which is accessible to us.

What an awakening for Europe! After two thousand years, she found herself in the same position to which she was raised by the profound intellect of India, and the acute genius of Greece, by Aristotle, Plato, Archimedes, and their emulators, from which, during those long ages, she was permitted to fall, whilst the work of the assimilation of races

was being carried on under the political influence of Rome.

What would have been the result if the learning of the Greeks, continuing its development from the third century before Christ to our own days, had pursued its triumphant march without hindrance? We do not know; no more than we can forecast the material resources of the human race after twenty centuries, nor to what heights the science of nature will have risen, should no social revolution create a breach in its tradition or retard its progress.

Greek art presents inimitable models; Greek philosophy has forestalled the modern schools in all their fearless opinions; and Greek science, not less prolific, paved the way which Europe has followed after long hesitation.

It is not difficult to connect Leucippus, a contemporary of Alexander the Great, who first clearly enunciated the philosophical doctrine of atoms, and the illustrious physicist of Manchester, Dalton, who, at the commencement of this century, founded, upon experiment, the atomic theory of modern chemists. Between these two points, so far removed, there is no intermediate link. Dalton is the son of Leucippus. Thus Cuvier, too, whose inventive genius was greater than that of Aristotle, was the sole inheritor of his spirit of order, his love of method, and his strength of judgment. In the same manner, we may ascend directly from Galileo and Newton, to Archimedes and Plato; the ideas of Faraday, too, on matter, atoms, force, and motion, were those of a Greek philosopher. The Romans did not receive this inheritance from the Greeks; given more to practical pursuits, they did not recognise the fact that these owed their progress to pure theory.

Truth is so beautiful that it deserves every effort a man can bestow to gain it; it is so fruitful that it carries along with it its own recompense. In placing before our mind the end, without occupying ourselves with particulars, we find the ordinary details of well-being and riches fall into their proper places.

Has not the atomic theory of Dalton, in assigning limits to phenomena, renewed the whole art of chemistry? Has Lavoisier's theory of combustion ever ceased to direct agriculture, the useful arts, health, and therapeutics? Did not these two philosophers contemplate abstract truth in all its splendour, and after receiving it from above, was it not sufficient for them to cast their eyes upon the earth, to reflect its light, and to spread far and wide its fruitful and exhaustless seed?

Let us, then, continue faithful in the cultivation of science for itself, and trust, without anxiety, that it will bear practical fruit for itself. Our remembrance of the life of Faraday teaches us that moral truth, when implanted in a man's heart, develops, at the proper time, each virtue that life exacts. His labours show us that the same holds good with scientific truth. At the proper time, it produces, as well as many spontaneous fruits, each of those discoveries which civilisation demands.

To a nation ambitious of becoming famous in history, it should be said "Despise conquest, abandon the pursuit of riches, and seek Truth, for by that your memory will be perpetuated." In like manner it may be said to a people who desire war or fear it, who wish to remain agriculturists or seek the advantages of commerce; "Search for Truth; it will create your means of defence or attack, maintain the fertility of your plains, and furnish your manufactories with resources against competition." The princes of bygone times considered themselves enriched and assured of prolonged youth, if they could obtain an alchemist capable of making gold, and possessed of a panacea against mortality. The nations of the present day, better advised, seek the aid of chemistry, and place in its counsels their hopes of well-being and honest gain: they know the value of artificial soda, chlorine, gas illumination, stearine candles and aniline dyes, and are grateful for the labour and care which these discoveries have cost.

Everything must give way to the laws of nature, and he only who has mastered those laws can control her processes. But the mastery cannot be obtained without a struggle; the fable of Proteus is a true picture of the combat between man, eager for knowledge, and the stubborn guardian, charged with the preservation of the secrets of destiny. Proteus changed himself into a thousand shapes before speaking, and yielded only to the hero who, far from being moved by his transformations, bound him with bands of increasing pressure. Such is nature herself, her answers are always true, but like the ancient shepherd of Neptune's flocks, before allowing Truth to shine forth, she arrays herself in the garments of error, or hides herself behind the phantoms of illusion; and will only assume her proper shape under the determined pressure of a resolute disciple of Science. This indomitable courage was possessed by Faraday in the highest degree.

The struggle for mastery is often prolonged. The whole life of a man does not suffice; the meeting of many philosophers animated by the same idea, or even the labours of different generations devoted to one pursuit, are required for the attainment of success; hence free associations for the cultivation of physical science and laboratories, where young men full of faith and ardour, working under one head, unite in the execution of such plans as he may invent or approve. Private study, which was perhaps best adapted to Faraday's temperament but which prevented him from establishing a school, has been succeeded by the labours in common of learned societies, and work carried on simultaneously by pupils in the same laboratory. Enlightened countries at last comprehend that all scientific research is a battle to be won, and that every victory increases national power. Intelligent nations no longer deny to scientific men, worthy the name of captain, either arms for the contest, soldiers devoted to their cause, or subsidies for their maintenance. Science is no longer an unrecognised power of which, nevertheless, much is expected; to day, every government which does nothing for it must expect to be vanquished by rivals, and to receive the censure of posterity for its want of forethought.

When Christopher Columbus set out for the conquest of the New World, did he not require ships, sailors, provisions, and ammunition? How then can the new world of science be conquered without assistance?

For textile manufactures there must be raw material, machinery, workpeople. The best workman in England, left to his own resources, would be unable to make an inch of cloth. It is the same with scientific discoveries; to weave the weft, there must be raw material, laboratories, apparatus, and reagents. The more eminent a scientific man may be, so much the more is he powerless to resolve unaided all the questions which arise in his mind,

and to develope all the views suggested to him by the new aspects of nature, which his penetration has reached.

How many *chefs-d'-œuvre* might have been lost to us if Raphäel, protected by an illustrious Pope, had not been the centre of a brilliant and devoted school, capable of sparing him the actual labour required to develope his ideas! What discoveries will be made when scientific masters of all countries, raised to their true position, are no longer limited in their resources, confined as to their means of execution, and obliged to do everything with their own hands!

The high position held by Faraday allows of such a comparison, and we may regret the loss of the discoveries which might have been added to those with which he has benefitted the world, if, like Raphäel, he would, or could, have founded a school. Learned societies formerly chose as a subject for their solemnities, an encomium on those monarchs or ministers whose protection they enjoyed. This meeting presents a spectacle more in conformity with the dignity of science: Faraday indeed raised himself above his fellows like a prince, but as a prince of thought; he exercised his power like a minister, but as a prime minister of the power and forces of nature.

His life is likewise an epoch of intellectual progress; and our immediate posterity will speak of such and such discoveries as having been made in the time of Faraday; sure of being as well understood as if referring to events in history, as being of the time of Elizabeth or Charlemagne.

But the life of Faraday is known to you, and you are familiar with his labours. I cannot fail of rendering that homage to his memory which he would have desired himself if, together with you, I review the progress of those sciences to which he was devoted.

Since the commencement of this century, three nations, animated with a noble spirit of rivalry—England, Germany, and France—have been contending for the first place in the study of physical science. Warranted, by turns, in claiming superiority, no one of them has dreamed, for one instant, of abdicating its claims. From this generous strife have sprung innumerable labours, the boast of our age, which will imprint a character upon it in history.

I do not wish to review, nor even to point out, the advantages that these nations have received from the liberal hand of science, but to bring before our minds the acquisitions to our knowledge of matter and force, to point out those fundamental ideas which have been brought to light, and to call to mind the part we must attribute to Faraday in this wonderful movement. I propose, then, to examine what we have learnt with regard to—1st, the nature of concrete matter; 2nd, the forces which it obeys; 3rd, the nature of truly-organised matter; 4th, the force which animates it.

The Greeks considered all matter divisible into four irresolvable elements, viz., earth, water, air, and fire, which are concrete representations of the abstract ideas solidity, liquidity, gaseous state, heat. So far they were guided by their senses; but they were of opinion that, finally, matter was made up of inaccessible atoms, and that variety, in the number or the arrangement of the latter, accounted for all the varieties in natural substances.

At the present day, with Lavoisier, we give the name of elements to all substances which we cannot break up or resolve; but hold, with Dalton, that these elements are themselves made up of atoms which unite in different proportions, and with varying arrangements, to form different compounds.

To sum up, matter can be reduced to substances which no longer admit of reduction, and these substances are the elements of modern chemists; matter has only three forms, the solid, the liquid, and the gaseous, which stand for the elementary substances of the Greeks; matter is agitated by different motions, which may be all represented by one alone—heat—as all the rest may be transformed into it.

Lavoisier demonstrates that these are substances which cannot be resolved into simpler parts, and these he calls elements; Dalton asserts that the latter are substances combined in unvarying proportions, and he gives the name of atoms to these proportions reduced to their simplest form. Are not the elements of Lavoisier subject to decomposition in their turn? Cannot the methods recognised by Dalton be brought under a more general statement? May not chemistry be in the same state as astronomy with Kepler's laws, and is it not waiting for its Newton?

We are inclined to believe in the absolute simplicity of Lavoisier's elements when we consider,—1st, that, since the commencement of civilisation, no power at man's disposal, no natural action observed by him, has been able to break them up; 2ndly, that when converted into gas, their atoms occupy the same space as before; 3rdly, that in the solid state their atoms have the same volume when we deal with analogous elements; 4thly, that in the last case their forms are identical, so that they can replace and displace one another mutually in their compounds, without any great change of properties; 5thly, that the heat required by atoms for a change of temperature, is the same, no matter how they differ in weight; lastly, that in order to separate them when united, any atom whatever requires the same amount of electricity as any other. But, with the exception of inalterability, all these properties, not excepting the last, one of Faraday's best discoveries, are found in all compounds of the same order; we have, then, only a right to say that Lavoisier's elements are substances of the same order, and if we may say that they *cannot* be resolved, it is only because they *have not* been resolved.

We are inclined to think Lavoisier's elements further reducible from considering—1st, their number, which has risen in less than a century from thirty-one to sixty-five, and which grows rapidly; 2nd, their natural classification by families, the different numbers of which approach gradually, like terms in a continous series; 3rd, their indubitable analogy with organic radicals, which are compounds.

In this way, Faraday's idea, that the atoms composing simple substances are collections of centres of force diversely arranged, may be defended. Chemical atoms would be the starting point of the analysis; mechanical atoms its last stage.

However, the question has entered upon another phase since the most recent discoveries. Natural philosophy has enabled us to determine the elements which are in incandescent matter, by means of the character of the spectrum formed by the latter.

The fact that Lavoisier's elements have resisted for the millions of years that they have been on the earth all the efforts of nature and of man to reduce them, is a characteristic of simplicity. Now we can

say that these elements have resisted every effort at destruction in space as well as in time. We find in the sun, in the fixed stars, in the nebulæ, and in comets themselves—that is, within our system and without our system—the elements which we have known on earth; we find the same metals, hydrogen, nitrogen, &c.

When we are taught by the beautiful discoveries of Messrs. Janssen, Lockyer, and Frankland, that the protuberances on the sun are only incandescent hydrogen, we ask, How shall it be possible to reduce this element if the temperature of the sun do not suffice for its reduction?

As far as man can go back in time, as far as man can reach by observation in space, the concrete elements of matter present the same character as Lavoisier's elements.

In their abstract forms, reduced to mere centres of force, these elements, if such be the name for matter in its final state, belong to an immense tract, and soar up into a region of thought, inaccessible to man both in space and in time.

The examination into the modifications which have taken place in our ideas on the subject of force authorises us in going back to an age long before the commencement of this, for from thence the changes in our ideas take their date. Then matter used to be placed under the dominion of universal attraction, of motion, of light, of heat, of electricity, of magnetism, of chemical affinity, of cohesion, of the force of solution, of capillary attraction, and, later, of endosmose, &c.

It was no longer the philosophy but the mythology of Greece that served as a model. Natural forces occupied the position with regard to modern science that the divinities of old did with respect to Olympus, and people came to attribute to the former, as they had done to the latter, distinct and inalienable personalities.

At the present day, we know that light and heat have many properties in common, that electricity can be changed into magnetism, and *vice versa*, and that mechanical action can produce heat, magnetism, electricity, light. This correlation of physical force, as Mr. Grove calls it, the data for which were given by Ampére, Melloni, and before them by Sady Carnot, and confirmed by the crucial experiments of Faraday, remove all doubt. These forces are different modes of motion, and all these modes of motion can be transformed one into the other.

The man with vulgar cravings sought for the transmutation of matter, and failed to find it; he had little care for the transmutation of forces, the deep meaning of which none but the philosopher understood, and as a reward for the disinterestedness of the latter, the truth was revealed to him.

One of my most eminent fellow-labourers, one of my countrymen who has many friends here, and whom you have heard in this theatre, M. Henry Ste. Claire Deville, has just proved the existence of a close alliance between affinity and mere physical attraction, by the discovery of dissociation, which will influence the progress of chemistry materially.

We cannot deny that there exists close relationship between affinity on the one hand, and mechanical force on the other, when we see the decomposition of a body, such as marble when submitted to the action of a steady heat, come to a stand in the same way and from the same causes as the vaporisation of a liquid *in vacuo*.

This is the first step that has been taken to bring chemical phenomena under the laws of mechanics, and to justify Newton's view that chemical attraction was a particular case of universal attraction.

Has not Mr. Graham, in turn, reduced to causes purely mechanical the manifold effects of diffusion, of endosmose, of capillarity? Has not this illustrious philosopher been led by his latest researches to manifest, not only the metallic character of hydrogen by a memorable discovery, but to seize the very moment at which the phenomenon of the mechanical condensation of a gas by a porous body changes into a truly chemical combination?

There remains, then, universal attraction which, acting on heavy bodies, guides the motion of the stars as well as that of atoms; a motion which produces heat, light, electricity, and magnetism.

The study of matter leads us to the knowledge of an ever-increasing number of elements, and of simpler and simpler forces. Matter which was always believed to be conceptible and susceptible of transmutation, has resisted the efforts of man; whereas physical forces which were considered to be beyond his reach are shown to be ephemeral, and change one into the other readily.

But what relation connects gravitation with the other forces in nature? We know not; and Faraday, who has meditated on this point all his life, and who has thrown such vivid light on all its surroundings, has not made one step towards the solution of the problem.

What is the cause of gravity itself? We now know no more than was known two hundred years ago, in Newton's time.

What is meant by organic matter? If one were influenced by the views of the old chemistry, there would be no difficulty in replying. All organic matter originated in plants or animals; it was destructible by heat; it contained, generally, carbon and hydrogen, often oxygen, sometimes azote. Thus it was a compound of which carbon formed the fundamental element, destruction by fire the chief characteristic, but which, above all, derived its organic character from the circumstances of its origin.

At that time, no one thought of confounding organic chemistry and mineral chemistry. At the present day, this fusion exists in all purely chemical substances; only the terms of this assimilation are not understood. We are dazzled by a quibble. My age, and the share I have had in this movement in science, compel me to explain clearly my opinion, and to endeavour to put an end to the misconception.

The first studies we pursue on the chemical phenomena of life teach us that plants create, and animals destroy, organic matter. The sun appears as the agent by whose means this matter is produced, and combustion by the air that animals breathe, as the process that destroys them, in order to restore their elements to the state of "brut" matter.

The chemical forces placed at the disposal of life, descending on the earth under the forces of light, disappear by radiating off into space under the form of heat. An equilibrium obtains between the vegetable and animal kingdoms for receipts and disbursements, represented by these two forms of motion—light and heat; and the amount of animal life which may be developed on the globe is measured by the amount of food that vegetable life has prepared for it. The dark rays of heat appear to carry off from the earth that which radiant and brilliant light has spread over it.

On looking more closely into it, however, it was found that matter of organic origin was divided into two groups; one so rich in species that it surpasses all that has ever been imagined of the very numerous species of plants or animals described by naturalists; the other containing but a very few distinct species.

The first group constitutes the true organic species of chemists; that is to say, those which they have analysed, of which they have recognised the constitution, which they make by means borrowed from from their own sciences, and of which they can, consequently, define the nature by analyses and syntheses.

Let us first attend to these matters. At what moment can they be characterised as organic?

Their origin does not suffice. In fact, carbon, hydrogen, oxygen, azote, can be withdrawn from plants or animals, and no one would find anything but mineral elements.

Oxide of carbon, carburetted hydrogen, cyanogen, water, and ammonia may meet in the produce of the constituents of plants or animals without anyone thinking of making organic substances from these binary compounds. But old chemists gave this name to alcohol, to vinegar, to the essence of bitter almonds, to urea, for example. Now, if there is any certain principle in science, it is this. Alcohol, vinegar, essence of bitter almonds, urea, although proceeding from plants or animals, have never lived, and will never live. They are subordinate products of life; they are not necessary instruments of life.

With regard to them, chemistry need no longer hesitate. This matter is formed in the manner of mineral matter. It shows all the conditions of its composition, its structure, and its properties. One circumstance only distinguishes it, and that, even, is not absolute. Generally, mineral matter is formed of simple elements, directly united. However, we perceive sometimes that certain composite groups may act like elements, may replace them or be replaced by them in combinations, without the latter changing their general character.

That which is the exception in mineral chemistry becomes the rule in organic chemistry. Lavoisier had the presentiment of this when he wrote—"Organic chemistry is the chemistry of compound radicals."

At this day, there is no longer any doubt. Cyanogen, cacodyle, the metallic radicals of Dr. Frankland, are well-known substances, offering all the chemical qualities of simple bodies, and nevertheless compound.

The substitutions admit of displacing and replacing one element by another, or even, at pleasure, by a compound radical in all the organic matter of chemists without changing its type. The converse is true: there is no impediment to replacing a compound radical by an element in a combination; and this change does not alter the type of it more.

Thus, the organic materials of which we speak are similar in all their conditions or qualities to mineral materials; 1st, they contain certain compounds which play the part of elements; 2nd, they assimilate with the oxides, sulphides, chlorides; with acids, bases and mineral salts in all their properties; 3rd, their radicals can replace the mineral elements, and be replaced by them; 4th, they can replace each other reciprocally.

Like "brut" bodies, these materials are susceptible of crystallisation, of volatilisation, without becoming decomposed; they form definite combinations, are incapable of life, and never have lived.

They thus resemble mineral matter in every respect, and where they differ from it is only that they have the general principles of compound radicals, whilst the mineral species have generally the principles of elements.

Analogies are even apparent in some numerical relations known to the elements of mineral chemistry, and to the radicals of organic chemistry. These relations are manifest in the two cases, for all elements susceptible of being arranged in series or natural families.

Thus, lithium, sodium, potassium, whose respective atomic weights are 7, 23, and 39, form a series of which the difference is 16. Magnesium, calcium, iron, whose respective atomic weights are 12, 20, 28, form a series whose difference is 8.

Thus all organic radicals offer the same condition. Methylium, ethylium, propylium, butylium, &c., give a series whose difference is 14, their respective atomic weights being 15, 29, 43, 57.

It seems natural to conclude from all this evidence, not that substances thus endowed and composed are organic because they are derived from organised beings, but rather that the elements of mineral chemistry may be complex.

In any case, the assimilation of the two chemistries becomes more and more near.

This picture would be incomplete if we did not add a few more features.

The radicals of mineral chemistry formerly numbered 30, and the combinations known in nature raised the number to some hundreds; at this day we count 65 elements, and some thousands of compounds or natural mineral species.

The chemist of the last century might study them one by one, and become acquainted with them all. Such is not the mission of the chemist of the present day; the species being realised, he tries to study them in groups; the potential species he tries to create. In nature, every element produces, on an average, eight or ten species. In the laboratory, every element may form thousands of the same order as the known mineral species.

The contrast is still more striking in organic nature. The animals and plants which cover the surface of the earth are counted by hundreds of thousands, and yet their tissues and their juices, submitted to chemical analysis, resolve themselves into no more than a few hundreds of distinct chemical species.

But the power of combination is such, among the special elements which form them, that it is by thousands that they have arisen; and if we calculate the number of combinations of this kind which may be realised, it seems as easy to count the grains of sand on one of the great shores of the sea as to say to what number of figures may be raised the organic species which the chemist has to produce.

Thus mineral or organic species, counted formerly by hundreds, are now counted by thousands for the first and by millions for the second.

Whence comes this fecundity for the formation of the so-called organic substances? Many circumstances contribute to it; but the first results from the almost incalculable number of the compound radicals which it can realise. Each of them being able to give birth to a prodigious number of combinations, organic chemistry counts a very great number of heads of tribes, and each tribe an infinite number of species. The latter, already multiplied in fact for simple ra[illegible]

cals, are much more so by the consequences of the fertile discovery of Mr. Williamson, which has taught us to unite two different radicals to each other, to bring them into a single system, and to produce with the latter as numerous compounds as were obtained from each of the isolated radicals. In consequence of the first and fundamental discovery of Mr. Graham, on the triple functions of phosphoric acid, which has been extended to the domain of organic chemistry,—for acids by M. Liebig,—for bases by M. Berthelot,—for alcohols by M. Wurtz, the result of this harmony of work, of which the immensity alarms the imagination, is that the atomic compounds with which we were chiefly engaged forty years ago, have not only been multiplied, but that they have been repeated by counterproofs. One might say, without forcing a metaphor, that we had visited and described all the rooms of the ground floor of the building; that Messrs. Graham and Liebig have revealed to us the existence of a first and second story, which repeated all their arrangements, and that Messrs. Berthelot and Wurtz have shown us that it was the same case in the basement and in the cellars. Thus five times more chambers or species have been produced at pleasure.

But, from all the sources of multiplication of substances with which organic chemistry is concerned, the most fertile is that of substitution; in fact, the discovery of the compound ammonias by M. Wurtz, and the labours of M. Hofmann which resulted from them, have produced a multitude of combinations, in which the atoms of hydrogen contained in ammonia are replaced by compound atoms performing the function of elements—that is to say, by organic radicals. If we apply the calculation to this special case, we even see that, with the known radicals employed to replace entirely, or in part, the hydrogen, or to replace each other mutually, we should henceforth be able to produce compounds derived from ammonia by hundreds of thousands or by millions.

How if we were to apply the same calculation, and the same prevision to all the types?

There is yet more. The chemist is not now, as formerly, obliged to derive all the substances that he produces by these means from those yielded by animals and vegetables; he creates them at will; he no longer needs, for his starting point, the action of solar light on plants. When he wishes to produce organic substances, he obtains his force by employing heat, formerly regarded as the true means of destroying them.

Not that he has succeeded in directly uniting carbon, hydrogen, oxygen, and nitrogen, so as to form organic substances; but, by the aid of heat alone, he first combines them two and two, and he thus forms carburetted hydrogen, carbonic oxide, cyanogen, water, and ammonia. Afterwards, by subjecting these first compounds to the action of suitable substances, and by the necessary artifices, he succeeds in regenerating, little by little, all the definite compounds of organic chemistry.

There is not a chemist who has not performed syntheses of this character; but the most striking is that of urea, by M. Wöhler; and the first, which have been grouped in a systematic manner are those which have been performed in Germany, by M. Kolbe; and especially those performed in France, by M. Berthelot, who has worked at them with great success, being the first to reproduce formic acid, and to combine directly carbon and hydrogen.

The function of the chemist changes, and becomes elevated. In presence of the numerous substances that his power evokes from the regions of the unknown, he owes his first attention to order, method, classification, and to nomenclature. But, once this first duty is fulfilled, he contemplates this innumerable host of forms, raised by his conceptions, or realised by his hands; and he applies to mathematics for a definition of the harmonies of numbers therein revealed; to mechanics, for a statement of the laws which their structures obey, or those which determine the stability of the material systems which they represent.

The Bible tells us that when God had formed, from dust, all the beasts of the earth, and all the fowls of the air, he made them pass before Adam, and that the name given to each by Adam is its true name.

In presence of this new creation, not of animated beings—whose appearance on earth depends on a power superior to his—but of harmonious forms which chemistry reproduces at will, always identical with each other, and always distinct from all others, man might sometimes forget that he has no longer merely to give names to the works of God, in order to remember that he has to name his own works.

If the discoveries which we have witnessed during the last half century do not justify pride, they at least excuse it. But, to bring back man to our appreciation of truth, it suffices to tell him that—if he has become more expert in the art of observing, if he employs with more certainty the art of experimenting, if the logic proper to the sciences leads him more surely to the discovery of the laws of nature—he has not as yet advanced one step towards the knowledge of causes.

Let us consider, in particular, what he knows on the subject of the materials which his life sets in motion in its development, and the contrast will be striking.

If I question the physiologist, on the subject of these millions, or milliards, of compounds, misnamed organic, of which the chemist transforms, reproduces, or creates at pleasure the species, he will reply to the three following questions:—Are these compounds living?—No! Have they lived?—No! Are they capable of living?—No!

If I ask the chemist himself if these compounds belong to mineral chemistry—to the chemistry of raw (brut) substances—he will reply, Yes!

Organised matter, not capable of being crystallised, but destructible by heat, the only matter which lives, or has ever lived—this matter, a subordinate agent of the vegetating power in plants, of the motion and sensation of animals, cannot be produced by chemistry; heat does not give birth to it; light continues to engender it under the influence of living bodies.

Let us not be disturbed by a quibble. The ancients admitted that nature alone produces organic matter, and that the art of the chemist is limited to transforming it. To-day we might, perhaps, even pretend that chemistry is powerful enough to replace, in all respects, the forces of life, and to imitate its processes; let us keep to the truth.

The ancients were mistaken when they confounded, under the name of *organic matter*, sugar and alcohol, which have never lived with the living tissue of plants or the flesh of animals. Sugar and alcohol have no more share of life than bone-earth, or salts contained in the various liquids. These remnants, or rubbish of life, placed amidst organic matter, are

true mineral species, which must be brought back to, and retained amongst, "brut" bodies. Chemistry may produce them in the same sense that she manufactures sulphuric acid or soda, without, for all that, having penetrated into the sanctuary of life.

This subject remains what it was—inaccessible, closed. Life is still the continuation of life; its origin is hidden from us as well as its end. We have never witnessed the beginning of life: we have never seen how it terminates.

The existing chemistry is, therefore, all powerful in the circle of mineral nature, even when its processes are carried on in the heart of the tissues of plants or of animals, and at their expense; and she has advanced no further than the chemistry of the ancients, in the knowledge of life and in the exact study of living matter; like them, she is ignorant of their mode of generation.

Where, then, is true organised matter, or matter susceptible of organisation? What is its chemical constitution? What is its mode of production? What is its manner of growth?

Instead of myriads of species, one would feel disposed to recognise but eight or ten at most, if one may be allowed to consider elementary types of organisation as chemical species. Be this as it may, in the origin of beings which have life we see cells appear, and in the heart of their types we find cells for organic elements, and, still beyond these, germs of cells.

In these cells, or in the spaces between them, we observe inert products, aliments, excretion, substances stored up. It is the cell, it is the germs which proceed from life, which live, which engender life, and then die. The substances which are contained in, or which surround these organs, are subordinate accidents, products rejected by organisation, or destined to its use, but distinct from life.

Every organised being is born of a germ; every plant from a seed; every animal from an egg. The physiologist has never seen the birth of a cell, excepting by the intervention or as the produce of a mother cell.

The chemist has never manufactured anything which, near or distant, was susceptible even of the appearance of life. Everything he has made in his laboratory belongs to "brut" matter; as soon as he approaches life and organisation, he is disarmed.

Thus, for a century past, the empirical elements of matter have been recognised and separated; their combinations have been multiplied to infinity; physical forces have been brought back to a common origin—motion—and one has been at pleasure changed into the other; and yet—

Is the intimate nature of matter known to us? No! Do we know the nature of the force which regulates the movement of the heavenly bodies and that of atoms? No! Do we know the nature of the principle of life? No!

Of what use, then, is science? What is the difference between the philosopher and the ignorant man?

In such questions the ignorant would fain believe they know everything; the philosopher is aware that he knows nothing. The ignorant do not hesitate to deny everything; the philosopher has the right and the courage to believe everything. He can point with his finger to the abyss which separates him from these great mysteries,—universal attraction which controls "brut" matter, life which is the source of organisation and of thought. He is conscious that knowledge of this kind is yet remote from him, that it advances far beyond him and above him.

No, life neither begins nor ends on the earth; and if we were not convinced that Faraday does not rest wholly under a cold stone, if we did not believe that his intelligence is present here among us and sympathises with us, and that his pure spirit contemplates us, we should not have assembled on this spot, you to honour his memory, I to pay him once more a sincere tribute of affection, of admiration, and respect!

ON JARGONIUM;

A NEW ELEMENTARY SUBSTANCE ASSOCIATED WITH ZIRCONIUM.*

By H. C. SORBY, F.R.S., &c.

AT the *soirée* of the President of the Royal Society, on March 6th, I exhibited various spectra, differing so much from those characteristic of any known substance that I considered myself warranted in concluding that they were evidence of a new element. Since this may be studied to the greatest advantage in the jargons from Ceylon, it appeared to me that, as the name *zirconium* has been adopted for the principal constituent of zircons, so that of *jargonium* would be very suitable for this constituent of jargons.

At the above-named *soirée* I gave away a printed account of the objects I exhibited; and in this I said that jargonia "is distinguished from zirconia and all other known substances by the following very remarkable properties. The natural silicate is almost, if not quite, colourless, and yet it gives a spectrum which shows above a dozen narrow black lines, much more distinct than even those characteristic of salts of didymium. When melted with borax it gives a glassy bead, clear and colourless, both hot and cold, and no traces of absorption bands can be seen in the spectrum; but, if the bead be saturated at a high temperature, and flamed, so that it may be filled with crystals of borate of jargonia, the spectrum shows four distinct absorption bands, unlike those due to any other known substance."†

I have since applied myself almost exclusively to the study of this substance, hoping to have been able to communicate to the Royal Society a full account of the subject this session; but so much still remains to be done that it is now impossible to do anything more than give a brief outline of the more important facts. The delay has not been because there is any difficulty in proving it to be a new substance, but because its properties are so unique, and have so much interest in connection with physics, that it appeared desirable to carefully examine all other known elements, in order to ascertain whether any of them exhibit analogous phenomena. That jargonium is quite distinct from zirconium is not only proved by the spectra, but also by other facts. Both myself and Mr. David Forbes have succeeded by entirely different processes in separating from jargons, zirconia apparently quite free from jargonia, and jargonia nearly, if not quite, free from zirconia; and, even if the separation be not perfect, it is, at all events, more than sufficient to prove that they are quite distinct. They are certainly very closely related, and are deposited from borax blowpipe beads in microscopical crystals of the same general form‡, quite unlike those characteristic of other known earths; but beyond this the

* Communicated by the author, having previously been sent to the Royal Society.

† For the further history of this subject, see Prof. Church's papers:—*Intellectual Observer*, 1866, vol. ix., p. 291; CHEMICAL NEWS, March 12th and 19th, 1869, vol. xix., pp. 121 and 142; *Athenæum*, March 27th; and also my own—CHEMICAL NEWS, vol. xix., p. 122; and *Athenæum*, April 3rd.

‡ See *Monthly Microscopical Journal*, June, 1869.

difference is as great as that between any other two allied elements. Judging from an analysis kindly made at my request by Mr. David Forbes, and from a comparison of the spectra, the amount of jargonia in jargons varies up to about 10 per cent. The entire or comparative absence of jargonia from the zircons of Miask, Fredericksvärn, and various other localities, appears to explain some of the facts which led Svanberg* to conclude that zircons contain more than one earth. He was so far correct, but failed to establish the existence of any substance with special chemical or physical properties; and if, as is probable, the Norwègian zircons, which, according to his views, contain such a notable quantity of this supposed new earth, as to have led him to give it the name *noria*, were from Fredericksvärn, and if the Siberian were from Miask, his norium cannot be looked upon as equivalent to my jargonium, which is almost or quite absent from those zircons.

The most remarkable peculiarity of jargonium is that its compounds may exist in three different crystalline states, giving spectra which differ from one another as much as those due to any three elements which give the most striking and characteristic spectra. Several substances can be obtained in two different physical states, giving different spectra, but usually only one of them is crystalline. The other is the vitreous or colloid condition. Crystalline minerals coloured by oxide of chromium do indeed show spectra of two different types; but, as far as I have yet seen, they never occur in the same mineral. In the case of jargonium, however, there are no less than *three* types of spectra, which are all met with in different crystalline modifications of the *self-same* compound.

The most characteristic test for jargonia is the spectrum of the borax blowpipe beads seen with a spectrum microscope, which enables us to detect it in zircons apparently

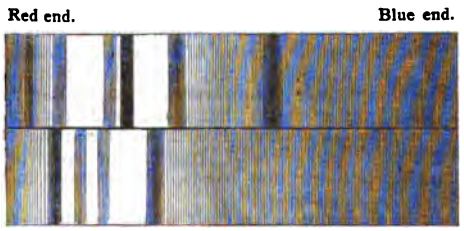

FIG. 1.

FIG. 2.

containing less than 1 per cent. As much of the earth or natural silicate as will completely dissolve should be melted in a circular loop of platinum wire about ¼ inch wide, with a mixture of borax and boric acid, and a strong heat kept up till crystals begin to be deposited, owing to the loss of the solvent by volatilisation. On removing the bead from the flame it remains clear and shows a few acicular crystals, but gives no absorption bands. On reheating to a temperature just below dull redness, the bead turns white, and so very opaque that no ordinary light will pass through it. When, however, a small and very bright image of the sun is formed in the centre by means of an almost hemispherical lens of ¼ inch diameter, and a cap is placed over the object glass, with a round hole of less diameter than the bead in the focus, so as to prevent the passage of extraneous light, the bead is seen to be illuminated by transmitted light of about the same brilliancy as that of a bright cloud, so that it gives an excellent spectrum without being at all dazzling.

In the case of beads conaining jargonia, the character of the spectrum differs completely according to the temperature at which the included crystals are deposited. As already mentioned, the clear glassy bead gives no absorption bands; and when the crystals of the borate are deposited at as low a temperature as possible, much below dull redness, and only just sufficiently high to soften the borax, there may be scarcely any trace of bands; but if the clear bead be quickly raised to a temperature just below that of very dull redness, it suddenly becomes very opaque, and shows a spectrum with a number of remarkably distinct absorption bands (Fig. 1). The most distinct and characteristic is that in the green, then one in the red and one in the blue, and there are three others fainter, one in the orange and two in the green. On raising the temperature to bright redness, all these vanish and four others appear, none of which coincide with any previously visible (Fig. 2). Three are situated in the red and orange and one in the green, so as to give rise to a spectrum of an entirely different character.* In this state the bead is of a pale straw colour. and not almost white as before. In the case of nearly pure jargonia the beads should not be above 1-25th of an inch thick, or else they would be too opaque. Pure zirconia gives no bands whatever in any state, and the beads are white, and sufficiently transparent when two or three times as thick as just named. It might be thought that these three different spectra were due to different compounds of boric acid and jargonia, if it were not that there is a similar series in the case of the natural crystalline silicate. Some of the jargons from Ceylon have a specific gravity very little inferior to that of pure zircons (4·70), and contain very little jargonia; but those of low gravity (4·20, or thereabouts) contain perhaps nearly 10 per cent, in a state which gives scarcely any trace of absorption bands. After keeping such at a bright red heat for some time, the specific gravity increases from about 4·20 to 4·60; and, judging from the imperfect data now known, this indicates that the volume of the silicate of jargonia is reduced to about one-half. The hardness becomes somewhat greater, and when examined with the spectrum microscope, the spectrum is found to be entirely changed. Instead of a mere trace of bands, a spectrum is seen which is more remarkable than that of any clear and transparent substance I have ever examined, with thirteen narrow black lines and one broader band.† No such changes occur in zircons free from jargonia like, those from Miask—no absorption bands are developed, and there is no increase in their specific gravity. In all cases this varies simply and directly as the amount of jargonia which passes from one state into the other; and if the bands are very distinct before ignition, the gravity is high and not much altered by heat.

Zircons, in their natural condition, from various localities, vary much in both the absolute and relative amount of these two modifications of jargonia; and there is good reason to believe that this difference in physical state may assist us very materially in determining the temperature at which certain rocks have been formed. Fortunately, I have met with one example of the third form of spectrum. A brown-red zircon, from Ceylon, was so dark in one part that I was not able to ascertain what sort of spectrum it would give in its unaltered condition. On heating to redness, the whole became a clear pale green; and, without examination with the spectroscope, no one would have suspected any difference between the different portions. That which was originally pale then showed the spectrum usually characteristic of heated jargons, whilst that which was originally very dark showed one entirely different, corresponding exactly with that of the borate deposited in blow-pipe beads at a medium temperature. It also corresponds in general character, but not in detail, with that of the blue spinels from Ceylon, which I believe contain a small quantity of jargonia. That part of the zircon which gives this spectrum appears to have had the same remarkably low specific gravity of about 4·0, both before and after ignition, as though the volume of the silicate of jargonia in this state were even greater than in that which gives no bands.

* *Pogg. Ann.*, 1845., vol. lxv., p. 327.

* June 30th.—I have since been able to examine these spectra with unusually good light, and have found another band in the blue in spectrum Fig. 1, and another in the extreme red in spectrum Fig. 2.

† CHEMICAL NEWS, vol. xix., p. 122.

These various spectra of jargonium are all of a very marked character, quite unlike those due to any other element in similar conditions.

The change produced by heating the jargons is, to some extent, analogous to what occurs on heating arragonite, but yet differs in many most important particulars. When arragonite is thus changed into calcite, it becomes an opaque mass of small crystals, the specific gravity and hardness are diminished, and there is no difference in the spectra of these two different modifications of carbonate of lime; whereas, after heating, the jargons are still as simple and transparent crystals as at first, the specific gravity and hardness are increased, and the spectrum totally changed. Iodide of mercury is an excellent illustration of a difference in the spectrum due to a change in the crystalline state, produced by heat; but there are only two modifications—the scarlet and the yellow. The existence of three crystalline conditions is, in some respects, analogous to what occurs in titanic acid. Anatase, brookite, and rutile are three distinct crystalline modifications of the same substance; but they do not differ very much in specific gravity, and their spectra do not present any characteristic differences. On the whole, the different states of carbon—charcoal, graphite, and diamond—are, perhaps, the best illustration of the existence of three distinct modifications, which differs much in specific gravity and optical characters; since one is black, the second has a metallic lustre, and the third is colourless and transparent; but these are variations in the element itself, and not, as in the case of jargonium, modifications of its compounds. So far as I am aware, there is indeed, no substance which shows strictly comparable facts.

There cannot, then, I think, be any doubt whatever that jargonium is not only a new elementary substance, but is, also, one likely to throw much light on several important physical questions. By the time that the Royal Society resumes its meetings, I trust that I shall be able to send a complete account of the whole of my investigations, including such facts connected with other substances as may serve to illustrate the very peculiar properties of this hitherto unrecognised element.

POSTSCRIPT (June 16th).

Since Professor Church has published some papers on the existence of a second earth in some zircons, it may perhaps be well to give a short account of what he has done. He was the first to observe the absorption bands, and gave an account of them in the *Intellectual Observer* for May, 1866 (vol. ix., p. 201). In that paper he said nothing about a *new* elementary substance, and does not even seem to have been convinced that they were not due to zirconia, since he speaks of silica as "the other constituent of zircons," as though there were but two constituents—silica and zirconia. However, since he had found that some zircons show the bands much better than others, he said that he was "induced to hazard the conjecture that it may be, after all, the presence of Svanberg's *norium* which determines the difference." I have now shown that jargonia may exist in very considerable quantity in zircons in such a physical condition as not to show any bands, and it was quite as probable that their presence or absence might have been due to a similar variation in the physical state of zirconia itself; and therefore no fact described in Professor Church's paper can now be looked upon as proof of the existence of a second earth. His paper does not appear to have attracted much attention and I was quite ignorant of it until after I had printed, for distribution at the *soirée* of the Royal Society on March 6th, an account of the characteristic peculiarities of jargonia. Up to that time he had never so much as even suggested the existence of a *new* earth, and the first time that he did so was in his paper subsequently published in the CHEMICAL NEWS of March 12th, manifestly written because he had "heard, when in London, that Mr. Sorby had discovered a new set of black absorption bands in certain zircons, and had attributed their occurence to the presence in the stones examined of a new element accompanying zirconium." In this paper he suggested that the name *nigrium* might be appropriately adopted, but did little more than recapitulate the arguments previously brought forward by Svanberg in proof of the existence of *norium*, viz., a difference in the specific gravity of the zircons, in the atomic weight of the earths, and in some obscure and doubtful chemical properties; but he never proved that the bands might not have been due to several well-known elements, and that the above-named differences depended on the substance which gives the peculiar spectrum. I therefore maintain that I was the first, not only to suggest, but also to prove, the existence of a new element by my blowpipe methods, and to show that the earth may be separated from zirconia and obtained in a state of approximate purity.

POSTSCRIPT (June 18th).

I here subjoin a brief account of tbe methods employed by Mr. David Forbes* and myself in separating zirconia and jargonia from one another. He separated apparently pure zirconia by means of strong hydrochloric acid, which dissolved the chloride of jargonium, but left chloride of zirconium undissolved, and obtained the approximately pure jargonia by adding to the solution excess of ammonia, and then considerable excess of tartaric acid, which left most of the tartrate of jargonia insoluble, but dissolved what may turn out to be a mixture of zirconia and jargonia with a third substance not yet sufficiently studied—perhaps Svanberg's noria. My own analysis was only qualitative. I fused powdered jargon with several times its weight of borax, which gave a perfectly clear glass, completely soluble in dilute hydrochloric acid. After separating the silica in the usual manner, a slight excess of ammonia was added to the hydrochloric acid solution of the earths, and then some oxalic and hydrochoric acids, which left undissolved apparently pure zirconia that had passed into an imperfectly soluble state. To this solution so much ammonia was added as to give a very copious precipitate, but yet to leave the solution with a very decided acid reaction. After removing the precipitate, which was chiefly oxalate of zirconia, almost or quite free from jargonia, excess of ammonia was added to the solution, and the washed precipitate digested in dilute hydrochloric acid to remove per oxide of iron. The insoluble portion must have been approximately pure oxalate of jargonia, for it gave the characteristic spectra described above in remarkable perfection. Though this method succeeded far better than I anticipated, I do not yet understand the exact conditions requisite to ensure success, and have been prevented by absence from home from making further experiments.

Jargonium.—We learn from the *American Journal of Mining*, of June 12th, 1869, that, at a meeting of the Polytechnic Association of the American Institute, held on June 3rd, a note was read "*On Jargonium*," which referred to the exhibition of jargonia by Mr. Sorby at the *soirée* of the Royal Society, and also to the communication by Professor Church in the CHEMICAL NEWS for March 12th. After the reading of the note, Dr. Isidor Walz spoke as follows:—"It will be remembered that, at a meeting of the New York Lyceum of Natural History, Professor Loew announced the discovery of jargonium before the number of the CHEMICAL NEWS which contained an account of Mr. Sorby's discovery had reached this country. The discovery was, undoubtedly, made by the English and American discoverers quite independently of each other."

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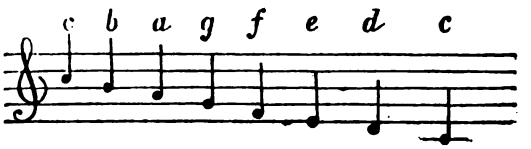
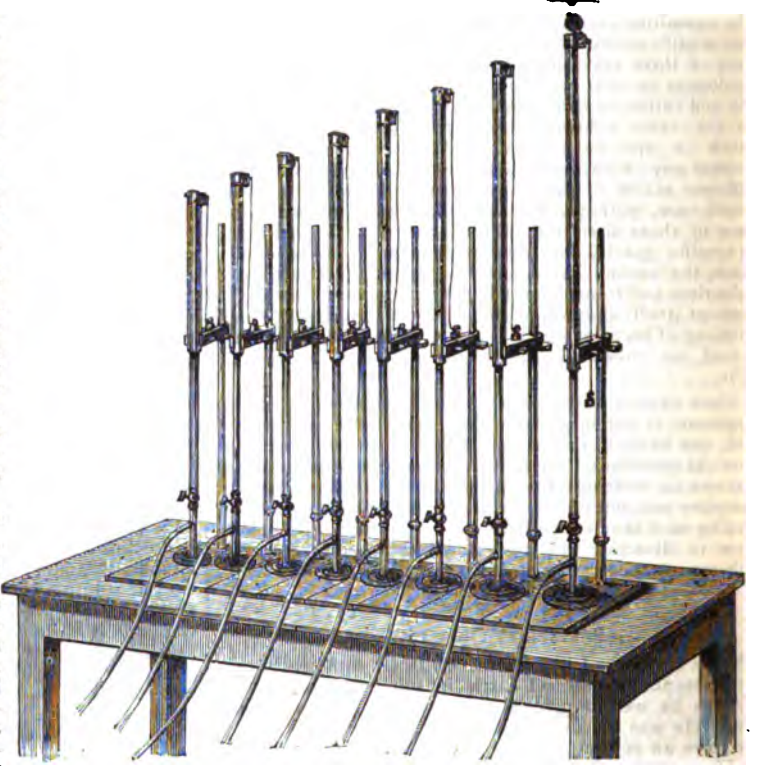
* CHEMICAL NEWS, vol. xix., p. 277.

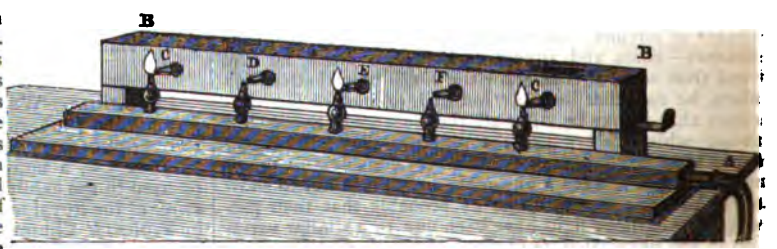
NOTICES OF BOOKS.

Cyclopædic Science Simplified. By J. H. Pepper. London: Frederick Warne and Co. New York: Scribner, Welford, and Co. 1869.

Of a verity this book is a small cyclopœdia of science; the variety of subject matter is astonishing, and six hundred woodcuts lend their aid to the simplification. Within the memory of most of us the only source of very popular science for boys was to be found in the "Boy's Own Book," where the science was bounded on the right by perhaps Cricket, and on the left by Boating, and the dominant experiment was the "Lead tree," while examples of chemical combination were ordered to be made somewhat after this fashion:—"Take a sixpence, put it in a small tea-cup, and pour upon it about a wine-glass full of aqua fortis; it will immediately dissolve; now add a pinch of salt, and the silver will fall down as a white powder," and so on. Now, for having led boys from such science as this, and given them sound science resulting from the labours of sound men, and often accompanied by their own explanations, we think every school-boy ought to thank Mr. Pepper. He cannot open this book without having his mind simultaneously opened, and it is his own fault if he ever closes it again.

As for subject matter, we have light, heat, electricity, magnetism, pneumatics, acoustics, and chemistry. In the article on Light, a detailed account, accompanied by woodcuts, is given of the celebrated ghost delusion, which surprised us all so much a few years ago, and of which M. Marion has given such a capital account in his *Merveilles de l'Optique*, one of that admirable series well called "Bibliothèque des Merveilles," from whatever point of view we may consider it.

If we specialise at all we may perhaps mention the chapter on Acoustics as being well illustrated. The accompanying figure represents the "gas flame organ," by means of which, we are told, simple tunes have been played; while in the second figure, we have the apparatus of Pichler for showing the position of the nodal points and ventral segments in a vibrating column of air. When the column of air in the tube, B B, is caused to vibrate, the gas jets, D and F, which are opposite to the centres of ventral segments, are blown out, while the jets, C, E, G, remain lighted, because they are opposite to nodal points—that is, points where the column of air is at rest.





Mr. Pepper also tells us lots of scientific "dodges," explains the talking head of Albertus Magnus, and indicates the true position of the "invisible girl," who, being in communication with "a sort of ornamental bedstead," yet all unseen, answers any questions addressed in the neighbourhood thereof. But there is much severer science than this; we would refer to the accounts of magnetism and dia-magnetism specially, also to the account of the Atlantic cable; in fact, we recommend all young fellows with any glimmer of a taste for science, to take the book home with them at the approaching summer holidays, to read it carefully, and, as far as is possible, experimentalise for themselves.

Endowment of a School of Practical Chemistry.—Mr. James Young, the late proprietor of the extensive works at Bathgate, near Glasgow, and manufacturer of paraffin and paraffin oils, whose name, in fact, is intimately associated with this manufacture as the discoverer of the process by which these valuable products have for many years been produced from certain varieties of coal, is stated to have presented the sum of £10,000 to the Andersonian Institution, Glasgow, for the endowment of a school of practical chemistry.—*Pharm. Journ.*

LABORATORY NOTES.

ACTION OF SODIUM ON WATER AND NITRIC ACID.

I send a few facts which you may perhaps consider worth a place in some corner of the CHEMICAL NEWS.

When sodium is thrown upon water, the hydrogen does not kindle, as we all well know, unless the water be warmed, or the metal confined to one spot by blotting-paper. If sodium, however, be dropped upon nitric acid of specific gravity 1·36 (ordinary commercial), the hydrogen burns with ease; but if the acid be diluted this result ceases. I thought it of interest to ascertain the point of dilution, which was conducted in the following way:—The concentrated acid, to the extent of 680 grains, was placed in a beaker, which again was placed in a vessel of water; a fragment of sodium of equal size was then added, the acid being diluted with 25 grains of water before each addition of sodium. The rise of temperature consequent upon this dilution (always two degrees) was allowed to fall back to that of 66° F., at which the experiments were commenced. Seventy-two experiments gave as the result, that the hydrogen ceased to kindle when the acid was diluted to specific gravity 1·056. The residue contained a fair amount of ammonia. I have used this dilute nitric acid with advantage, when showing the preparation of hydrogen by potassium and sodium as a lecture experiment, as the results then appear similar. No doubt the rapid oxidation of the sodium into nitrate is the explanation.—I am, &c.,

THOMAS BLOXAM,
Lecturer on Chemical and Natural Philosophy, Cheltenham College.

CORRESPONDENCE.

THE FARADAY MEMORIAL.

To the Editor of the Chemical News.

SIR,—I read with regret that the proposed memorial to Faraday is to be in the form of a statue in St. Paul's Cathedral. I am very sorry to differ from those who, doubtless knowing Faraday better than I did, though they could not have loved him more, support this proposal. Government has refused to contribute anything to the memory of this great man on the ground that he did not hold the position of a public servant. Had he been a fighting man, doubtless a statue would have been raised to his honour. But why should we attempt to rival Government in erecting a statue in a state church? Ought we not rather to make our memorial take a scientific and beneficent form, such as Faraday himself would have approved? England can do many things well, but she cannot make an artistic statue. Why then should we waste this splendid opportunity of doing good in the production of a wooden figure at great cost? And the good I would propose, is the creation of a permanent fund for the encouragement of poor students in science, and poor investigators. Many would give—I for one—their five guineas to such a fund, who would withhold it if the money is to be spent on stone. There are poor boys in poor schools who display an unusual amount of talent, but for want of means or patronage have no opportunity of rising. Could not such boys be collected in a Faraday College, and trained up in science? We might thus get the pick of undeveloped talent throughout these islands.

Faraday, who shunned empty titles, does not want a statue. His kindly feeling was always extended to workers in science. I have several times received a word of encouragement from him, either written or spoken, when it was most refreshing because most needed. I will mention an example of his self-denying kindness which is not, I believe, known, although thousands of such cases might be collected, for no one came in contact with Faraday without receiving some benefit.

Mr. Weale, the publisher, told me that a scientific man having agreed to write a book for him, delivered the copy and then had to go abroad. Mr. Weale read the proof-sheets. In one sheet several difficulties occurred which he could not solve. Not knowing who to apply to, he bethought himself of Faraday, although personally unknown to him. The messenger arrived at the Royal Institution, delivered the parcel, and said he would wait. "It is of no use," said the porter, "Mr. Faraday is unwell and is ordered out of town; he is just going to start." While the messenger was remonstrating, Faraday appeared, carpet-bag in hand, took the packet, and read the letter. "O, yes," said he, "I will do this for Mr. Weale. I can go by the next train."

Can the memory of such a man be honoured by resorting to the worn-out custom of erecting an ugly statue?—I am, &c.,

F.R.S.

June 25th, 1869.

SUPERPHOSPHATES.

To the Editor of the Chemical News.

SIR,—I observe in the CHEMICAL NEWS of last week an enquiry regarding the possibility of distinguishing between mineral and bone phosphates in superphosphates. If your correspondent will take two samples, one of a bone-ash and the other a coprolite superphosphate, and precipitate the insoluble phosphate by ammonia, and burn the precipitates, he will see that there is such a marked difference in the appearance of the two as to render it very easy to distinguish the one from the other.

Should your correspondent desire it, I shall be most happy to give him any information I can on the subject.—I am, &c.,

ARTHUR E. DAVIES, Ph.D.

Analytical Laboratory,
St. Mary's Gate, Manchester,
June 30th, 1869.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

Comptes Rendus des Séances de l'Académie des Sciences (No. 25), June 21, 1869.

Omitting the purely astronomical, mathematical, and other memoirs and papers of no direct interest to readers of our paper, we notice a memoir—

On a Homologue and Isomer of Choline.—M. Wurtz.—The author says—Some time ago I pointed out that, when chlorhydrate of glycol fixes and combines with trimethylamine, the result is the formation of a new basis identical with neurine as obtainable from brain. Since the identity of choline, which M. Strecker has extracted from liver, and the base just alluded to, has been proved, I shall call neurine henceforward choline. The reaction above mentioned is represented by the following formulæ:—

$$\underbrace{(C_2H_3)_3N}_{\text{Triethyl-amine.}} + \underbrace{C_2H_4\left\{\begin{matrix}OH\\Cl\end{matrix}\right.}_{\text{Chlorhydrate of glycol.}} = \underbrace{\left.\begin{matrix}C_2H_4.OH\\(C_2H_3)_3\end{matrix}\right\}NCl.}_{\text{Chlorhydrate of hydroxethylentri-ethylammonium.}}$$

This salt is soluble in water and alcohol, crystallises in prisms, and yields, with chloride of platinum, a crystalline double-salt made up according to the following formula:—

$$\left[\frac{C_2H_4.OH}{(C_2H_5)_3}N.Cl\right]_2 + PtCl_4.$$

The hydrate of hydroxethylen of triethylammonium, $C_8H_{21}NO_2$, is evidently a homologue of chinoline, $C_9H_{15}NO_2$. The author's paper describes, at very great length, the preparation of many complex compounds like those named, and, lastly, promises a detailed account of this portion of his labours.

Some Isopropylic Compounds.—M. Da Silva.—Butyrate of isopropyl is a colourless liquid; odour disagreeable; boils at 128° C.; is inflammable, and burns with a bright flame. Its vapour density is 4·73.—Valerate of isopropyl is also a liquid, colourless, inflammable, of a disagreeable odour, and of less density than water. Its specific gravity, at 0° C., is 0·8702; vapour density, 5·004; and boils at 142° C.

Coal-Tar Oils which Boil at about 200° C.—M. Romier.—The author says—Having obtained, through the kindness of the chief engineer and chemist of the United Parisian Gas Works Company, M. Audouin, 16 litres of heavy coal-tar oil, I have therefrom obtained about 4 litres of oil, perfectly freed from naphthaline, phenol, and alkaloids, and boiling at between 170° and 225° C. Leaving out of the subject of his research all fluids contained in the aforesaid 4 litres boiling below 176° C., and which in bulk represented 3¼ litres, the author has obtained three oils of constant boiling point, respectively boiling at between 176° and 179°, at between 196° and 198°, and, lastly, at between 200° and 225° C. These oils are colourless, lighter than water, and exhibit an odour reminding one of that of oil of turpentine; they have been submitted to a series of experiments; and the author states that they are cymens and hydrides of formen.

Analysis of the Meteorite of Kernouve, near Cléguérec, Morbihan, Fallen on the 22nd of May last.—M. Pisani.—The entire weight of this mass, before it was broken up, was about 80 kilos.; the piece from which a portion has been applied for analysis weighed 16 kilos. The specific gravity of this meteorite is, on an average, 3·747. The result of the analysis, in 100 parts, was as follows:—Iron, 22·25; nickel, 1·55; sulphur, 2·15; copper, a trace; chromate of iron, a trace; silica, 32·95; alumina, 3·19; protoxide of iron, 11·70; magnesia, 23·68; lime, 1·89; soda, with traces of potassa, 1·41.

Polytechnisches Centralblatt, No. 9, May 1, 1869.

We do not propose regularly to quote this periodical, which is chiefly devoted to mechanics and engineering; but whenever it happens to contain, either original papers of interest to our readers, or, as now and then occurs, abstracts of interest from German, Swedish, or Russian periodicals, which from their limited circulation have not become generally known, we shall make the necessary abstracts.

Ready Method of Preparing Phosphuretted Hydrogen Gas.—Dr. H. Schwartz says, When the pulverulent metallic zinc which is deposited in the tubes of the Belgian (Vieille Montagne) zinc smelting furnaces, is mixed with amorphous phosphorus in powder, in the proportion of one part of zinc to two of phosphorus, and this mixture, after having been introduced into a hard-glass combustion tube, is gently heated therein, while, at the same time, a current of dry coal gas or dry hydrogen gas is passed through the mixture, phosphide of zinc is formed; it is necessary to cool the tube and mixture while the current of gas remains turned on. From the phosphide of zinc so obtained phosphuretted hydrogen may be readily prepared by means of dilute sulphuric acid, or by boiling with caustic potassa solution; the gas evolved is, however, the non-spontaneously combustible kind; the spontaneously combustible gas may be obtained by applying a larger quantity of the phosphide of zinc and warm dilute sulphuric acid.

Analysis of some Colouring Substances used for Staining Glass and Faience Ware.—Dr. H. Schwartz.—A bright brown colour was found to consist in 100 parts of—Oxide of chromium, 11·30; peroxide of iron, 21·00; alumina, 18·02; oxide of zinc, 50·90; this material may be prepared as follows: 71 grms. of chrome alum; 60 grms. of persulphate of iron; 160 grms. of alum, and 180 grms. of sulphate of zinc, are dissolved in water, and after having been mixed, precipitated by means of carbonate of soda, collected on a filter, washed, dried, gently ignited, and rubbed to powder in an agate mortar; a reddish brown colour consisted in 100 parts of—Oxide of barium, 19·82; oxide of chromium, 11·07; peroxide of iron, 7·70; alumina, 2·30; Silica, 10·40; Sulphuric acid, 5·47; carbonic acid and alkali, 3·81.

Bulletin de l'Academie Imperiale des Sciences de St. Petersbourg, Vol. xiii.

This periodical contains only one paper relating to chemistry—A memoir, or rather, and more correctly, a fresh instalment of a memoir:—

On Hydrocarbons.—M. F. Fritzsche.—(Read at the meeting of the 4th of February last). The author says, I call Photen the substance $C_{14}H_{10}$, fusing at 210° C.; in pure state it is always a somewhat yellowish coloured solid, soluble in very strong alcohol, exhibiting in solid as well as in a fused state a violet fluorescence. Phosen, another hydrocarbon, fuses at 193° C.; by the action of sunlight this substance is entirely altered in its properties, and the so altered matter is called paraphosphen by the author; by simple fusion this latter is again converted into phosen. The author describes at great length the preparation in pure state of the two substances alluded to, discusses their crystallographical properties; describes oxyphoten $C_{14}H_8O_2$; oxybinitrophoten, dioxyretisten $C_{14}H_{14}O_2$; but these descriptions and the record of the properties, and mode of preparation of these substances, are so lengthy, and, moreover, so interspersed with discussions on other, although not in this respect quite irrevelant, matter, that it is impossible to give a condensed abstract which will do justice to the author.

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1641. J. Wilson, Royal Exchange Buildings, London, "Improvements in the manufacture of wrought iron."—A communication from I. O. York, New York, U.S.A.—Petition recorded May 28, 1869.

1713. I. Hopkinson, Leeds, "Improvements in the manufacture of artificial fuel."

1717. F. Rave, Manchester, "An improved method of extracting colour from vegetable matter."

1719. W. V. Morgan, Cannon Street, London. "Improvements in the manufacture of crucibles and other refractory articles or vessels."—A communication from J. L. Hall, and J. V. Morgan, Montreal, Canada.

1721. J. H. Johnson, Lincoln's-Inn-Fields, Middlesex, "Improvements in the manufacture of iron."—A communication from J. Burt, Detroit, Michigan, U.S.A.—June 3, 1869.

1731. J. Duke, Mannamead, near Plymouth, "Improvements in the manufacture of plaster and cement."—June 4, 1869.

1742. T. W. Arkle, Liverpool, "Improvements in the mode and means for extracting, recovering, or collecting copper from water containing the same in solution, and in apparatus therefor."—June, 5, 1869.

1782. A. St. C. Radisson, Lyons, France "Improvements in the treatment of oleine and other fatty matters for the purpose of transforming them into solid materials suitable for the manufacture of candles."

1785. W. L. Wise, Adelphi, Westminster, "Improvements in the manufacture of artificial fuel and in apparatus for the purpose."—A communication from B. Le Quesne and Dumontier, St. Servan, France.—June 9, 1869.

1800. G. W. Oliver, Liverpool, "Improvements in the manufacture of explosive powder and in machinery to be used in such manufacture."—A communication from P. A. Oliver, New York, U.S.A.—June 10, 1869.

NOTICES TO PROCEED.

319. W. A. Smith, Manchester, "Improvements in the preservation of meat, fish, and other perishable articles of food during their carriage by railway, and in apparatus connected therewith."—Petition recorded February 2, 1869.

374. H. A. Bonneville, Chaussée d'Antin, Paris, "A new and improved compound for preparing jelly broth."—A communication from C. J. Desnoix, Paris.—February 6, 1869.

420. J. Clayton, Radcliffe, Lancashire, "An improved paste for fixing and brightening aniline and pigment colours in printing on cotton, woollen, silk, or mixed fabrics."—February 10, 1869.

442. W. E. Newton, Chancery Lane, "Improvements in the manufacture of explosive compounds."—A communication from A. Nobel, Paris.—February 12, 1869.

637. J. Townsend and P. Forbes, Glasgow, N.B., "Improvements in refining or purifying oils and fats."—March 2. 1869.

942. E. Morewood, Rock Cottage, Briton Ferry, Glamorganshire, "Improvements in coating metals."—March 29, 1869.

1317. A. Meredith, Newgate Street, London, "Improvements in the manufacture of iron and steel."—April 28, 1869.

1469. J. Townsend and P. Forbes, Glasgow, N.B., "Improvements in refining or treating oils and fats, and in apparatus therefor.—May 13, 1869.

1539. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved process for obtaining gelatine and other products from animal substances."—A communication from D. K. Tuttle, O. Lingo, W. J. Hooper, and T. Hooper, Baltimore, Ma., U.S.A.—May 19, 1869.

1575. C. W. Siemens, Great George Street, Westminster, "Improvements in calcining and smelting ores, and in furnaces and apparatus employed in connection therewith, which furnaces are also applicable to other purposes."—May 21, 1869.

1642. J. Brömer and H. Gurzkow, Frankfort-on-the-Maine, "An improved method of obtaining the anthracen out of asphaltos, that is to say, pitch produced from coal tar, and of preparing two colouring matters from the anthracen."—May 28, 1869.

TO CORRESPONDENTS.

*** *In consequence of the enlargement of our Journal by the introduction of abstracts of all the foreign periodicals, the index is much larger than it has hitherto been; we have therefore issued with this a supplement, which contains the title-page, preface, and a copious index to the volume just completed. The price is the same as for an ordinary number.*

THE CHEMICAL NEWS.

VOL. XX. No. 502.

ON

HEAT TREATED AS A SCIENCE OF KINETICS.*

By G. F. RODWELL, F.C.S.

I.

WE are surrounded by actions which we cannot readily recognise. There are actions of the nature of those which constitute light—differing not in kind, and but slightly in degree—which are unseen; there are other actions, similar to those which constitute sound, which are unheard; and others, again, similar to those which constitute heat, which are unfelt. Vast ranges of phenomena are beyond the direct cognisance of the senses. The organs by which external impressions are received and conveyed to the brain, although admirably perfect,—I need not say far *more* perfect than our most delicate and refined instruments—are yet, be it remembered, exercised solely in regard to the welfare of the organism of which they form a part. They are devoted to that organism, and exist for the purpose of enabling it to resist adverse assaults, whether of external agencies, or otherwise; to comply with all the demands requisite for the conditions of life, and to transform the external actions of the material world into actions capable of being recognised under some definite form by the centre of perception—the brain. The actions, or motions, which are thus received and transmitted by the nerves, are such alone as are requisite for the well-being of the entire organism. Light, sound, and heat are varieties of motion; but the nerves of seeing, hearing, and feeling only transmit certain of those motions: if they pass a well-defined limit of quickness or slowness, they cease to be transmitted. But these same relatively quick and relatively slow motions, although incapable of being directly recognised by us, do not the less profoundly influence matter. It is the object of natural philosophy to investigate *all* the actions by which matter is influenced.

Thus our senses are limited in their capability of observation. Their operations are finite. Hence, when we pass from the influence of the so-called *physical forces*—light, heat, electricity, chemical action—upon ourselves to their influence upon matter external to ourselves, it is necessary for us to assist and exact the capabilities of the senses in the particular direction required, and to free the intellect from impressions produced by unaided observation, the bias so resulting, and from the *idola specus* of which Bacon speaks, for we have all of us in our minds "*specum sive cavernam quæ lumen naturæ frangit et corrumpit.*" It therefore behoves us when we study natural philosophy—specially any branch of it submitted to a mode of treatment more assimilable with reason, but less so, perchance, with unaided observation than some older and long-dominant system—it behoves us, I say, to receive with caution, and to carefully examine and analyse the impressions conveyed to us by our unassisted senses, and to put from our minds all preconceived notions, whether derived from directly-received impression, or indirectly from the authority of some older physical system; and this I will ask you to do at the outset. And when, as will frequently be the case, I shall have to speak to you of minute, invisible particles or molecules of matter, endued with functions, attributes, and influences, diverse in form, and varied in character, and such alone as we are wont to associate with larger masses of matter, capable of being seen, and handled, and weighed, I will ask you to grant me some faith, and some imagination. If you find difficulty in doing this in this particular direction, remember that every grain of sand upon the sea-shore is a microcosm, sharing in the innate motions which pulsate through the Universe; and remember, further, that there are specks, infinitely smaller than grains of sand, in which a heart beats, and blood circulates, and all the functions of an exuberant vitality are exercised; and thus, by comparing the unknown with the known, faith may be lessened, and imagination not too tensely stretched.

I had intended to have adopted a different name for the subject of this course from that which appears on the syllabus; to have replaced the word *heat* by some term which, as I thought, would better associate in your minds the idea of motion with that of heat; such as *thermo-kinetics* (from θερμος heat; and κινησις, motion), or *thermo-dynamics*; or to have spoken of it as *a certain motion appertaining to matter*. I had intended to have done this, when, on enquiring into the etymology of our word *heat*, I found that the term is peculiarly appropriate, although the science which it designates has, of late, undergone the most profound changes. The word *heat* is closely related to the Anglo-Saxon *haets*, the Gothic *haitan*, the Icelandic *hita*, and the old High German *eit*; and these words agree, by Grimm's law, with the Greek αιθος, fire, from αιθω, to kindle; mark, also, the related words αιθοψ, αιθυσσω, and (perhaps) αιθηρ. The celebrated philologist Bopp, carries back the derivation to a Sanskrit root—*indhi*, to shine; and traces it through the Greek αιθος, the Latin *æstus*, and the old High German *eit*, to our word *heat*. "*Æstus*," says Vossius, in his "Lexicon Etymologicon," *est commotio, vel in igne, vel in aqua, vel in animo. Omnis autem commotio fervorem gignit.*" Now, as it will be my object to show that heat *is* a commotion of the small particles or *molecules** of matter, I think you will agree with me that the term could not be changed with advantage.

From an early age, the idea of motion has, in some form or other, been associated with that of heat. I may remind you that, in αιθυσσω, to put in rapid motion, to kindle (from αιθω), we have distinct reference to this; and, moreover, that αιθηρ, from which we have our word *ether*, was sometimes used to express fire. From the supposed proximity of the sphere of ether to the sphere of fire, and the generation of the latter from the former, the ether was sometimes regarded by the ancients as a very pure fire; invisible all-pervading, and in perpetual motion; indeed, as a something approaching to the nature of what we now call heat. Now if, as Aristotle affirms, αιθηρ is derived from αει, always, and θεω, to move swiftly, we have here additional evidence that, at an early period, the idea of motion was associated with that of heat.

"*Æstus est commotio . . . omnis commotio fervorem gignit.*" I will define heat as a rapid motion of molecules of matter. This motion, when transmitted to the brain by the molecules of the sensory nerves, produces in us the sensation by which heat is familiarly known.

Let us now briefly trace the rise of the two theories which for so long a time prevailed in regard to the nature of heat. Epicurus regarded heat as an efluxion of minute spherical particles which, in virtue of their smallness, and of the rapidity of their motion, insinuate themselves into the densest substances, and thus expand, and eventually disintegrate them. Lucretius, who followed Epicurus somewhat closely, maintained that both light and heat are caused by the vehement motion of small primary particles—*primi minuti*, as he calls them. The majority of the ancient philosophers regarded fire (under which term was included both light and heat) as an element more divine than air, water, and earth; it was to them the acting agent of the Universe, the *force* exercising itself upon *matter*. The function of fire is well signified in the story of Prometheus, who, you will remember, is related to have stolen fire from heaven, and therewith

* A course of four lectures delivered at the London Institution.

* *Molecula*, a little mass; a Low Latin diminutive of *moles*, a mass; a mass of incommensurable minuteness.

vivified mankind. Fire was the *anima*, while tangible matter was the *corpus*.

The ideas of the ancients regarding the nature of heat were very generally adopted during the middle ages. Cardanus frequently speaks of *motus ignis* and *motus caloris*. Telesius, of Cosenza, a philosopher far in advance of his time, asserted that heat is the cause of motion, cold of rest, and that these principles together produce all the phenomena of the universe. Robert Fludd (also known as Robertus de Fluctibus), the founder of the Fluddists, affirmed that heat is the ultimate effect of the action of light, and that it results from the motion of material particles. Francis Bacon was one of the first to deny the elemental nature of fire, by asserting that it is "merely compounded of the conjunction of light and heat in any substance;" elsewhere he defines heat as "not an expansive motion of the whole, but of the small parts of a body." As an example of the production of heat by the transformation of visible motion, he mentions that a piece of metal when hammered becomes hot, and that if the hammering were continued, it would possibly become red-hot.*

About twenty years after the death of Bacon, the *Principia* of Descartes appeared. In it we find the development of one of the most comprehensive kinetic systems which has ever appeared in the history of science. (By *kinetic system* I mean a system in which the phenomena of the universe are accounted for on the supposition that they are caused by various motions). It is impossible at the present time to enter into any detail account of the Cartesian philosophy. I may mention, however, that Descartes supposed the existence of three elements, by the mutual interaction of which all natural phenomena are produced. The first element, the *materia cælestis*, corresponding somewhat to the *αιθηρ* of the Ancients, is a very subtle medium, possessing perpetual and vehement circular motion, and it is the cause of all the motion in the universe; the second element is more gross, and it embraces all gaseous matter, while the third element embraces all solids and liquids. Thus the first element, which actuates by its motion the second and third elements, corresponds somewhat with what we now call a *force*. Heat, according to Descartes, is a rapid circular motion of the particles of the third element, communicated by the materia cælestis. The particles of oils and fats, and of combustible bodies generally, are peculiarly adapted to the reception of this motion, and such bodies he designated "potentially hot." Among other passages which bear upon the kinetic theory of heat, I find the following in the fourth book of the *Principia*:—"A nail which is being driven into a block of wood does not become hot until after it has been driven home by the hammer, because heat is not a motion of masses, but of small particles, and so long as the nail itself is capable of moving, the force of the blow is expended in producing the motion of a mass, not in moving the small particles of the metal." The nature of heat, according to the Kinetic theory, received a very apt expression in the following definition given by John Locke:—"Heat is a very brisk agitation of the insensible parts of the object, which produces in us that sensation from which we denominate the object hot; so that what in our sensation is *heat* in the object is nothing but motion."

Towards the close of the seventeenth century, there arose a theory which endeavoured to trace the cause of a number of phenomena to the absorption or rejection of "*materia aut principium ignis, non ipse ignis*," better known as the theory of Phlogiston (from *φλογιστος*, burnt). This theory profoundly influenced the scientific world for more than a century, and it led to an extended theory of materialised heat.

We thus perceive that there had gradually arisen two distinct theories in regard to the nature of heat, for while some regarded it as a motion of the molecules of matter,—as a condition, or attribute of matter, others regarded it as matter itself, subtle indeed, and infinitely thin, but yet a kind of matter capable of being absorbed or rejected by other and grosser matter. The former of these is the *Kinetic theory of heat*, (*κινησις*, motion), and is now generally, if not universally, adopted; the latter is the *material theory of heat* (*materia*, matter), and it was almost universally adopted during the last, and far into the present, century.

According to the materialists, substances have heat stored up in them. A metal becomes hot when it is hammered because its particles are approximated, and the heat is, as it were, squeezed out of it, as water is squeezed out of a sponge. The metal, before being hammered, was said to possess a *greater capacity for heat* than the hammered metal. In a similar manner they accounted for the production of heat by friction and percussion; the possibility of producing new heat was denied, and the amount in the universe was considered incapable of variation.

In 1798, Count Rumford, while engaged in the boring of cannon in the Arsenal of Munich, observed, with surprise, the large amount of heat which was produced during the process, and the apparently unlimited extent of its production. Now, he reasoned, if the explanation of the materialists be correct, it follows that all the heat observed in the cannon, and in the separated borings, results from the altered capacity for heat of a few ounces of metal borings. But, on examination, they were found to possess precisely the same capacity for heat as an equal weight of the solid metal, hence the explanation offered by the materialists was clearly fallacious. Rumford afterwards constructed a special machine for the production of heat by friction. It consisted of a metal cylinder in which a blunt steel borer was caused to revolve by horse-power. The cylinder was surrounded by a casing, in which was placed about 2½ gallons of water. When the borer was caused to revolve, the temperature of the water gradually rose, until, in two hours and a half, the whole quantity of water commenced to boil—a conclusive proof of the unlimited production of heat by mechanical means. A few years later, Sir Humphry Davy conclusively proved the immateriality of heat, by demonstrating the liquefaction of two pieces of ice submitted to friction in a freezing atmosphere. Now, it was admitted—even by the materialists, who contested every inch of ground—that water possesses more heat than ice at the same temperature, hence, if their explanation were valid, ice ought not to liquefy when submitted to friction in a freezing atmosphere.

Although the fallacy of the material theory was thus proved early in the century, the theory was by no means abandoned, and it continued to be generally adopted (when *any* theory at all of heat was adopted), until it was shown that a definite relationship exists between heat and mechanical work, and that they are mutually convertible. This determination of the so-called *mechanical equivalent of heat* was made almost simultaneously by Dr. Julius

* Some time ago a correspondent enquired in this journal if iron could really be hammered until it becomes red-hot, and some discussion was elicited on the subject, the general conclusion appearing to be that it is one of the many things which are much talked of, but never seen. I recently asked a blacksmith if he could do it, and he replied that he had never seen it done, but would try. In the first place a piece of very tough iron was hammered with a moderately heavy hammer; it became hot, but scarcely sufficiently so to scorch a piece of paper upon which it was placed. It was then hammered by two men, one of whom used a sledge hammer, but the iron scarcely became hotter than before. Presently a man who was working in the shop said he had often lit his forge fire by the means when matches were less plentiful than now, and he accordingly took a nail, such as is used for shoeing horses, and after hammering with a light hammer for less than two minutes, part of the nail was brought to a bright red heat. It thus appears that there is a good deal of knack in the operation; the blows were light but frequent, and the nail was turned at each blow, with something of the alternating motion which is adopted in feathering an oar; that is, if we suppose the nail to be square, it was turned, so as to receive one blow upon a surface A, the second on a contiguous side B, the third on A again, and so on, these two surfaces being struck alternately. A few months ago I saw a heavily laden omnibus rapidly descending Pentonville-hill with a locked wheel; before reaching the bottom of the hill the bearing surface of the locked wheel was glowing with a bright red heat, and the adjacent woodwork was on fire.

Mayer, of Heilbronn, in Wurtemburg, and by Mr. Joule, of Manchester, in the year 1842. Mayer worked out his result rather by reasoning upon known facts than by direct experiment, while Joule instituted a lengthy and elaborate series of experiments, which were published in their entirety in 1850. Since this date, the kinetic theory of heat has been largely developed by the labours of Hirn, Helmholtz, and Sir William Thomson, and notably by Professor Clausius, of Zurich.

Let us now turn our attention to Joule's determination of the relationship existing between heat and mechanical work, or, more correctly, and in accordance with the definition of heat with which we started, of the amount of mass motion equivalent to and convertible into a definite amount of molecular motion. In this country, the unit of mechanical work (known as the *foot-pound*) is the mechanical force necessary to lift 1 lb. to a height of 1 foot *in vacuo*, and the unit of heat is the quantity of heat necessary to raise 1 lb. of water 1° F. in temperature strictly from 55° to 56° F. On the Continent, the unit of work (called a *kilogrammetre*) is the mechanical force necessary to lift 1 kilogramme to a height of 1 metre *in vacuo*, and the unit of heat is the quantity of heat necessary to raise 1 kilogramme of water from 0° C. to 1° C. Sometimes the quantity of heat necessary to raise 1 lb. of water from 0° to 1° C. is adopted as a unit of heat in this country.

Now the simplest and most definite form of mechanical force is the falling of a known weight through a known space under the influence of the force of gravity; and this form of force was employed by Mr. Joule to produce heat by friction. A falling weight was caused to communicate rotary motion to a paddle working respectively in water and in mercury, and to produce the revolution of cast-iron discs in contact; and the increase of temperature resulting from the friction was measured by thermometers which could be read to 1-200th of a degree Fahrenheit. The rise of temperature for each experiment was—in the case of water, 0·563° F.; mercury, 2·41° F.; and cast-iron, 4·3° F.+ By this method, Joule ascertained that a weight of 1 lb., falling from a height of 772 feet, produces, on its collision with the earth, an amount of heat competent to raise the temperature of 1 lb. of water 1° F. (that is to say, to generate one unit of heat). Mayer, by a perfectly distinct method, found the number to be 771·4 feet—a difference of less than 0·1 per cent; hence there can be no doubt concerning the accuracy of the determinations.

Let us next consider the various modes by which heat may be generated—the various causes which tend to produce a rapid motion in the molecules of matter; and this brings us at once to the subject of *energy*.

Energy (ενεργεια, action, operation) is a term used in physics to designate the power of doing work against or overcoming the action of force, whether it be—(α) the attraction of masses acting through a sensible space (*gravity*); (β) the attraction of similar molecules acting through an insensible space (*cohesion*); (γ) the attraction of dissimilar molecules acting through an insensible space (*chemical affinity*); (δ) the attraction of molecules in different electrical or magnetic conditions (*electrical and magnetic attraction*), or any action whatsoever which it may be possible to resist. In fact, we may attach to the term energy almost the same meaning as it possesses when applied to ourselves. Energy is competent to exist in two conditions; viz., as *potential energy*, or possible energy; and as *kinetic energy*, or actual energy; and these may be likened to energy of character, and to energy of action in ourselves.

Potential energy, or energy of position, or possible energy, or, as Helmholtz calls it, energy of tension, is energy existing in possibility, not in act, as in the case of a ball suspended above the surface of the earth, or an arrow resting upon a tense bow-string.

Kinetic energy, or energy of motion, or dynamic energy, or *vis viva*, or mechanical energy (for by these various names you will find it designated in different books), is the actual energy of a body in motion; as in the case of a ball falling to the earth's surface, or an arrow projected from a released bow-string.

Now, when the kinetic energy of a mass is suddenly arrested—as by collision with a larger mass—it is transformed into the motion of molecules—it becomes heat; and it has been found that the heat thus produced is dependent upon the mass of the moving body multiplied by the square of its velocity, that is, $h = mv^2$. From this, it follows that, if the velocity of a projectile be doubled, the heat developed on the stoppage of its motion will be increased fourfold; if trebled, ninefold; if quadrupled, sixteenfold; and so on. It has thus been calculated that a rifle-bullet, moving with a velocity of 1338 feet per second, develops, upon striking the target, sufficient heat to raise its temperature 1080° F., an amount more than sufficient to fuse it; but we must remember that this heat is shared between the bullet and the target. But, in the application of this law, we may pass from the arrested motion of a rifle-bullet to that of far larger masses of matter. Mayer and Helmholtz have calculated the amount of heat which would be produced by the stoppage of the earth in its orbit, and have determined that it would be sufficient not alone to fuse, but actually to vaporise the earth. The heat thus generated would be equal to that produced by the burning of fourteen spheres of coal, each equal to the earth in magnitude.

The amount of energy in the Universe is constant; we can neither add to it nor take from it; the only possible change is from one form to another; and this is called the principle of the *conservation of energy*.

Potential energy is constantly being converted into kinetic energy, and kinetic energy as constantly into heat. Friction, percussion, and compression, and the partial or complete stoppage of motion in any form, and by any means whatsoever, afford examples of this. (I.)—*By Friction.*—Lucretius tells us that fire was first made known to mortals, either by clouds meeting violently in collision and dashing out sparks of fire, or by the excessive friction of the branches of trees in a forest, induced by high winds, and resulting in fire. Friction has, from the earliest ages, been employed as a means of producing fire, and in our modern matches, although the labour is lessened, we still adopt the means. (The many experiments which illustrate this part of the subject are too well known to need detail here. Phosphorus may be readily ignited by the heat of friction (α) of a pointed piece of wood rubbed in a wooden groove; (β) of a gimlet which has been used for boring wood, or (γ) of a saw which has been used for sawing; (δ) by the heat resulting from the friction of the crystalline fibres of tin, by bending a rod of that metal repeatedly in opposite directions; and a number of examples will suggest themselves at once without further mention.) (II.)—*By Percussion.*—A piece of metal when hammered becomes hot, and may readily be brought to a red heat. When a pistol is cocked, potential energy is conferred upon the hammer; it is comparable to a raised weight: when the trigger is pulled, the potential energy becomes kinetic; when the hammer strikes the cap the kinetic energy becomes heat equal to that expended in raising the hammer. (III.) - *By Compression.*—A piece of wood, compressed in an hydraulic press, becomes warmer than before. In the rolling of the metals (as at the Mint), the bar, before passing between the rollers, is cold, but, after compression, it comes out so intensely heated that water assumes the spheroidal condition when poured upon it.

+ If water be violently shaken in a bottle for less than a minute, a rise of temperature of from 0·7° to 0·8° F. ensues; and, in the case of mercury, of from 1·3° to 1·5° F. Of course, in both cases, if the bottles are shaken by the hand, they must be surrounded by several layers of thick flannel, to prevent any communication of heat from the hand. Mr. Herschell has ingeniously shown the heating of mercury by agitation by communicating rapid reciprocal motion to a tube containing a small quantity of that metal, and then placing a piece of phosphorus on its surface: immediate ignition is the result.

(IV.)—*By Chemical Action.*—The production of heat by chemical action is probably due to the conversion of the kinetic energy of molecules into heat, as in the above instances, the heat resulted from the conversion of the kinetic energy of *masses*. (Instances of the production of heat by chemical action are too numerous to require notice here; take the combination of sulphuric anhydride with water, or of iodine with phosphorus, as examples.) Molecules, chemically separated, are in the condition of a raised weight, the energy which has been expended in separating them has overcome the force of chemical attraction, and removed the molecules out of its range; when they once again come within the range of the attraction, they rush together and unite chemically; their potential energy becomes kinetic, and the kinetic energy becomes heat. (V.)—*By Electricity in Motion.*—When kinetic electricity passes through a thin wire which offers some resistance to its passage, heat is copiously produced. (The production of heat by the energy of electricity in motion cannot be accounted for until we know more of the nature of electricity. Possibly, in the above experiment, the electricity so agitates the molecules of the conducting wire that, while transmitting its own motion, a collision of molecules results, and a consequent production of heat; or, in other words, the electricity may indirectly confer kinetic energy upon the molecules of the conducting wire, which energy is resolved into heat.)

The reverse of the above action also takes place. Heat is consumed—(α) in the production of mechanical work as in heat engines, the most prominent example of which is the steam-engine; (β) in the separation of molecules chemically united, as in any instance of decomposition by heat; and (γ) in the production of kinetic electricity, as in the thermo-electric pile. Mayer, writing in 1842, says, "A locomotive may be compared to a distilling apparatus; the heat applied under the boiler passes off as motion, and this is deposited as heat at the axles of the wheels."* Sparks may be frequently observed at the point of contact of the break-wheels and the rail at any of the "Metropolitan Railway" stations. The trains on this line keep up their speed until they are on the point of entering the station, hence their motion is more suddenly arrested than that of trains in general, and hence the above result. The loss of molecular motion (cold) which results from the performance of work, may be readily shown by causing a gas to perform work, as when the receiver of an air-pump is rapidly exhausted, the production of cold is shown by the deposit of moisture upon the sides of the receiver; it may also be readily shown by a Breguet's helix; or, again, when a cork is projected from a soda-water bottle, cold results. The condition of the cork at any moment can be clearly defined by bearing in mind that which has been said above on the subject of energy. At the outset the cork is in a condition of potential energy, for it has a greater pressure upon its under than upon its upper surface, and is hence competent to do work against gravity; when the string is cut, the potential energy becomes kinetic, and the cork is projected into the air. At any moment of its flight before attaining the final altitude, it possesses both potential and kinetic energy, for it possesses potential energy capable of causing it to fall through the space intervening between it and the earth, *plus* the kinetic energy which will raise it to the final altitude; when the latter is attained, the energy is obviously all potential, and the potential energy is not entirely transformed into kinetic until the cork reaches the earth; on its collision, heat is produced equal to that consumed in projecting it from the bottle.

Ink for Writing on Glass.—A solution of fluoride of ammonia is recommended as furnishing a ready means of writing with a pen of any kind upon glass, and is especially adapted for labelling bottles, cylinder-tubes, &c., in the laboratory, as well as for marking the degrees upon hydrometers and apparatus of similar construction.—*American Artisan.*

* "On the Forces of Inorganic Nature." These essays were translated a few years ago, and were published in the *Philosophical Magazine.*

ADDITIONAL

OBSERVATIONS ON HYDROGENIUM.*

By THOMAS GRAHAM, F.R.S., Master of the Mint.

From the elongation of a palladium wire, caused by the occlusion of hydrogen, the density of hydrogenium was inferred to be a little under 2. But it is now to be remarked that another number of half that amount may be deduced with equal probability from the same experimental data. This double result is a consequence of the singular permanent shortening of the palladium wire observed after the expulsion of hydrogen. In a particular observation formerly described, for instance, a wire of 609·14 m.m. increased in length to 618·92 m.m. when charged with hydrogen, and fell to 599·44 m.m. when the hydrogen was extracted. The elongation was 9·77 m.m., and the absolute shortening or retraction 9·7 m.m., making the extreme difference in length amount to 19·47 m.m. The elongation and retraction would appear, indeed, to be equal. Now it is by no means impossible that the volume added to the wire by the hydrogenium is represented by the elongation and retraction taken together, and not by the elongation alone, as hitherto assumed. It is only necessary to suppose that the retraction of the palladium molecules takes place the moment the hydrogenium is first absorbed, instead of being deferred till the latter is expelled; for the righting of the particles of the palladium wire (which are in a state of excessive tension in the direction of the length of the wire) may as well take place in the act of the absorption of the hydrogenium as in the expulsion of that element. It may, indeed, appear most probable in the abstract that the mobility of the palladium particle is determined by the first entrance of the hydrogenium. The hydrogenium will then be assumed to occupy double the space previously allotted to it, and the density of the metal will be reduced to one-half of the former estimate. In the experiment referred to, the volume of hydrogenium in the alloy will rise from 4·68 per cent to 9·36 per cent, and the density of hydrogenium will fall from 1·708 to 0·854, according to the new calculation. In a series of four observations upon the same wire, previously recorded, the whole retractions rather exceeded the whole elongations, the first amounting to 23·99 m.m., and the last to 21·38 m.m. Their united amount would justify a still greater reduction in the density of hydrogenium, namely to 0·8051.

The first experiment, however, in hydrogenating any palladium wire appears to be the most uniform in its results. The expulsion of the hydrogen afterwards by heat always injures the structure of the wire more or less, and probable affects the regularity of the expansion afterwards in different directions. The equality of the expansion and the retraction in a first experiment appears, also, to be a matter of certainty. This is a curious molecular fact, of which we are unable as yet to see the full import. In illustration, another experiment upon a pure palladium wire may be detailed. This wire, which was new, took up a full charge of hydrogen, namely, 956·3 volumes, and increased in length from 609·585 to 619·354 m.m. The elongation was, therefore, 9·769 m.m. With the expulsion of the hydrogen afterwards, the wire was permanently shortened to 600·115 m.m. It thus fell 9·470 m.m. below its normal or first length. The elongation and retraction are here within 0·3 m.m. of equality. The two charges taken together amount to 19·239 m.m., and their sum represents the increase of the wire in length due to the addition of hydrogenium. It represents a linear expansion of 3·205 on 100, with a cubic expansion of 9·827 on 100. The composition of the wire comes to be represented as being—

	In volume.	
Palladium	100·000	or 90·895
Hydrogenium	9·827	or 9·105
	109·827	or 100·000

* Read before the Royal Society, June, 1869.

The specific gravity of the palladium was 12·3, the weight of the wire 1·554 grm., and its volume 0·126 cub. centim. The occluded hydrogen measured 120·5 cub. centims. The weight of the same would be 0·0108 grm., and the volume of the hydrogenium 0·012382 cub. centim. (100 : 9·827 : : 0·126 : 0·01238). The density of the hydrogenium is therefore

$$\frac{0{\cdot}0108}{0{\cdot}01238} = 0{\cdot}872.$$

This is a near approach to the preceding result, 0·854. Calculated on the old method, the last experiment would give a density of 1·758.

It was incidentally observed, on a former occasion, that palladium alloyed with silver continues to occlude hydrogen. This property is now found to belong generally to palladium alloys, when the second metal does not much exceed one-half of the mixture. These alloys are all enlarged in dimensions when they acquire hydrogenium. It was interesting to perceive that the expansion was greater than happens to pure palladium, about twice as much; and that, on afterwards expelling the hydrogen by heat, the fixed alloy returned to its original length *without any further shortening of the wire*. The embarrassing retraction of the palladium has, in fact, disappeared.

The fusion of the alloys employed was kindly effected for me by Messrs. Matthey and Sellon, when the proportion of palladium was considerable, by the instrumentality of M. Deville's gas furnace, in which coal gas is burned with pure oxygen; or by means of a coke furnace, when the metals yielded to a moderate temperature. The alloy was always drawn out into wire if possible, but if not sufficiently ductile, it was extended by rolling into a form of a thin ribbon. The elongation caused by the addition of hydrogenium was ascertained by measuring the wire or ribbon stretched over a graduated scale, as in the former experiments.

1. *Palladium, Platinum, and Hydrogenium.*—Palladium was fused with platinum, a metal of its own class, and gave an alloy consisting, according to analysis, of 76·03 parts of the former, and 23·97 parts of the latter. This alloy was very malleable and ductile. Its specific gravity was 12·64. Like pure palladium, it absorbed hydrogen, evolved on its surface in the acid fluid of the galvanometer, with great avidity.

A wire 601·845 m.m. in length (23·69 inches) was increased to 618·288 m.m., on occluding 701·9 volumes of hydrogen gas measured at 0° C. and 0·76 barom. This is a linear elongation of 16·443 m.m. (0·6472 inch), or 2·732 on a length of 100. It corresponds with a cubic expansion of 8·423 volumes on 100 volumes; and the product may be represented—

	In volume.
Fixed metals	100·000 or 92·225
Hydrogenium	8·423 or 7·775
	108·423 or 100·000

The elements for the calculation of the density of hydrogenium are the following, the assumption being made as formerly, that the metals are united without condensation:—

Original weight of the wire, 4·722 grms.
Original volume of the wire, 0·373 cub. centim.
Volume of the hydrogen extracted, 264·5 cub. centims.
Weight of the hydrogen extracted, by calculation, 0·0237 grm.

The volume of the hydrogenium will be to the volume of the wire (0·373 cub. centim.) as 100 is to 8·423; that is, 0·03141 cub. centim. Finally, dividing the weight of the hydrogenium by its bulk, 0·0237 by 0·03141, the density of hydrogenium is found to be 0·7545.

On expelling all hydrogen from the wire at a red heat, the latter returned to its first dimensions as exactly as could be measured. The platinum present appears to sustain the palladium, so that no retraction of that metal is allowed to take place. This alloy therefore displays the true increase of volume following the acquisition of hydrogenium, without the singular complication of the retraction of the fixed metal. It now appears clear that the retraction of pure palladium must occur on the first entrance of hydrogen into the metal. The elongation of the wire due to the hydrogenium is negatived thereby to the extent of about one-half, and the apparent bulk of the hydrogenium is reduced to the same extent. Hydrogenium came in consequence to be represented of double its true density.

The compound alloy returns to its original density (12·64) upon the expulsion of the hydrogen, showing that hydrogen leaves without producing porosity in the metal. No absorptive power for vapours, like that of charcoal, was acquired.

The same wire of palladium and platinum, charged a second time with hydrogen, underwent an increase in length from 601·845 to 618·2, or sensibly the same as before. The gas measured 258 c.c., or 619·6 times the volume of the wire. The product may be represented as consisting of—

	By volume.
Fixed metals	92·272
Hydrogenium	7·728
	100·000

The density of hydrogenium deducible from this experiment is 0·7401. The mean of the two experiments is 0·7473.

2. *Palladium, Gold, and Hydrogenium.*—Palladium fused with gold formed a malleable alloy, consisting of 75·21 parts of the former and 24·79 parts of the latter, of a white colour, which could be drawn into wire. Its specific gravity was 13·1. Of this wire 601·85 m.m. occluded 464·2 volumes of hydrogen, with an increase in length of 11·5 m.m. This is a linear elongation of 1·91 on 100, and a cubic expansion of 5·84 on 100. The resulting composition was therefore as follows:—

	In volume.
Alloy of palladium and gold ..	100·00 or 94·48
Hydrogenium	5·84 or 5·52
	105·84 100·00

The weight of the wire was 5·334 grms.
The volume of the wire was 0·4071 c.c.
The volume of hydrogen extracted, 189 c.c.
The weight of the hydrogen, 0·01693 grm.
The volume of the hydrogenium, 0·02378 c.c.
Consequently the density of the hydrogenium is 0·711.

The wire returned to its original length after the extraction of the hydrogen, and there was no retraction.

The results of a second experiment on the same wire were almost identical with the preceding.

The elongation on 601·85 m.m. of wire was 13·3 m.m., with the occlusion of 463·7 volumes of hydrogen. This is a linear expansion of 1·902 on 100, and a cubic expansion of 5·81 on 100. The volume of hydrogen gas extracted was 188·8 c.c., of which the weight is 0·016916 grm. The volume of the hydrogenium was 0·02365 c.c., that of the palladium gold alloy being 0·4071 c.c. Hence the density of the hydrogenium is 0·715.

In a third experiment, made on a shorter length of the same wire, viz., 241·2 m.m., the amount of gas occluded was very similar, viz., 468 volumes, and was not increased by protracting the exposure of the wire for the long period of 20 hours. There can be little doubt, then, of the uniformity of the hydrogenium combination, the volume of gas occluded in the three experiments being 464·2, 463·7, and 468 volumes. The linear expansion was 1·9 on 100 in the third experiment, and therefore similar also to the preceding experiments.

The hydrogenium may be supposed to be in direct combination with the palladium only, as gold by itself shows no attraction for the former element. In the first experi-

ment the hydrogenium is in the proportion of 0·3151 to 100 palladium and gold together. This gives 0·3939 hydrogenium to 100 palladium; while a whole equivalent of hydrogenium is 0·939 to 100 palladium.* The hydrogenium found is, by calculation, 0·4195 equivalent, or one equivalent hydrogenium to 2·383 equivalents palladium, which comes nearer to two equivalents of the former with five of the latter than to any other proportion.

To ascertain the smallest proportion of gold which prevents retraction, an alloy was made by fusing seven parts of that metal with 93 parts of palladium, which had a specific gravity of 13·05. The button was rolled into a thin strip and charged with hydrogen by the wet method. An occlusion of 585·44 volumes of gas took place, with a linear expansion of 1·7 on 100. A retraction followed to nearly the same extent on afterwards expelling the hydrogen by heat.

With another alloy, produced by fusing 10 of gold with 90 of palladium, the occlusion of gas was 475 volumes, the linear expansion 1·65 on 100. The retraction on expelling the gas afterwards was extremely slight. To nullify the retraction of the palladium, about 10 per cent of gold appears therefore to be required in the alloy.

Another alloy of palladium of sp. gr. 13·1, and containing 14·79 per cent of gold, underwent no retraction on losing hydrogen, as already stated.

The presence of so much gold in the alloy as half its weight did not materially reduce the occluding power of the palladium. Such an alloy was capable of holding 459·9 times its volume of hydrogen, with a linear expansion of 1·67 per cent.

3. *Palladium, Silver, and Hydrogenium.*—The occluding power of palladium appeared to be entirely lost when that metal was alloyed with much more than its own weight of any fixed metal. Palladium alloys containing 80, 75, and 70 per cent of silver, occluded no hydrogen whatever.

With about 50 per cent of silver, palladium rolled into a thin strip occluded 400·6 volumes of hydrogen. It expanded 1·64 part in 100 in length, and returned to its original dimensions without retraction upon the expulsion of the gas. The specific gravity of this silver-palladium alloy was 11·8; the density of the hydrogenium 0·727.

An alloy, which was formed of 66 parts of palladium and 34 parts of silver, had the specific gravity 11·45. It was drawn into wire, and found to absorb 511·37 volumes of hydrogen. The length of the wire increased from 609·601 to 619·532 m.m. This is a linear elongation of 1·629 on 100, or cubic expansion of 4·97 on 100. The weight of the wire was 3·483 grms.; its volume 0·3041 c.c. The absolute volume of occluded hydrogen was 125·1 c.c., of which the weight is 0·01120896. The volume of the hydrogenium was 0·015105 c.c. The resulting density of hydrogenium is 0·742.

In a repetition of the experiment upon another portion of the same wire, 407·7 volumes of hydrogen were occluded, and the wire increased in length from 609·601 m.m. to 619·44 m.m. This is a linear expansion of 1·614 part on 100, and a cubic expansion of 4·92 on 100. The absolute volume of hydrogen gas occluded was 124·0 c.c., and its calculated weight 0·01111 grm. The volume of the hydrogenium being 0·1496 c.c., the density of hydrogenium indicated is 0·741. The two experiments are, indeed, almost identical. The wire returned in both experiments to its original length exactly after the extraction of the gas.

4. *Palladium, Nickel, and Hydrogenium.*—The alloy, consisting of equal parts of palladium and nickel, was white, hard, and readily extensible. Its specific gravity was 11·22. This alloy occluded 69·76 volumes of hydrogen, with a linear expansion of 0·2 per cent. It suffered no retraction below its normal length on the expulsion of the gas by heat.

An alloy of equal parts of *bismuth* and palladium was a brittle mass that did not admit of being rolled. It occluded no hydrogen, after exposure to that gas as the negative electrode, in an acid fluid for a period of 18 hours. It seems probable that malleability and the colloid character, which are wanting in this bismuth alloy, are essential to the occlusion of hydrogen by a palladium alloy.

An alloy of one part of *copper* and six parts of palladium proved moderately extensible, but absorbed no sensible amount of hydrogen. The metallic laminæ which remain on digesting this alloy in hydrochloric acid, and which were found by M. Debray to be a definite alloy of palladium and copper (PdCu), exhibited no sensible occluding power.

The conclusions suggested as to the density of hydrogenium, by the compound with palladium alone and by the compounds with palladium alloys, are as follows:—

	Density of Hydrogenium observed.
When united with palladium	0·8540 to 0·8720
When united with palladium and platinum	0·7401 to 0·7545
When united with palladium and gold ..	0·7110 to 0·7150
When united with palladium and silver ..	0·7270 to 0·7420

The results, it will be observed, are most uniform with the compound alloys, in which retraction is avoided, and they lie between 0·711 and 0·7545. It may be argued that hydrogenium is likely to be condensed somewhat in combination, and that consequently the smallest number (0·711) is likely to be the nearest to the truth. But the mean of the two extreme numbers will probably be admitted as a more legitimate deduction from the experiments on the compounds alloys, and 0·733 be accepted provisionally as the approximate density of hydrogenium.

I have the pleasure to repeat my acknowledgments to Mr. W. C. Roberts for his valuable assistance in this inquiry.

* H = 1; Pd = 106·5.

ON CRYSTALS INCLOSED IN BLOWPIPE BEADS.

By H. C. SORBY, F.R.S., &c.

AT the *soirée* of the Royal Society on March 6, by the kind assistance of my friend Mr. Wm. Baker, I exhibited a number of blowpipe beads inclosing various crystals of such extreme beauty as mere microscopical objects, that probably some account of them may be interesting, independently of their connection with chemistry and mineralogy.

It has long deen known that blowpipe beads often become opaque on flaming; and Emerson* showed that, by proper manipulation, well-formed crystals can be produced in them, and recognised by their characteristic forms when magnified. Rose† described very interesting results thus obtained in the case of titanic acid; and Captain Ross has published several papers in the CHEMICAL NEWS,‡ in which he gives the results obtained by blowing out the beads into thin vesicles, exhibiting minute characteristic crystals. My method differs materially from those described by the above-named authors. I use borax as the solvent, and, if requisite, add various reagents to produce, as it were, precipitates of characteristic crystalline form. By keeping the supersaturated fused beads over the flame, crystals may be obtained in cases where, according to Emerson nothing satisfactory results from mere flaming: and the addition of various reagents adds greatly to our resources in the cases of earths variously mixed or combined with mineral acids. It is not my intention to enter now into the purely chemical part of the subject, or to show its application to mineralogy. I shall merely give a short account of some specimens thus prepared, which may be of interest as microscopical objects of remarkable character. Many are good illustrations of the manner in which crystals grow up from the simple nuclei to compli-

* *Proceedings of the American Academy*, 1866, vol. vi., p. 4[illegible].
† *Berlin Acad. Bericht*, 1867, pp. 129, 450.
‡ Vol. xvi., p. 370; vol. xvii., pp. 35, 63, 84, 87, and 107.

cated forms of extreme beauty; and it is very instructive to see how the definite secondary planes of the crystals, viewed as a whole, are produced by the regularly graduated growth of numerous small crystals symmetrically deposited. This is sometimes so striking as to lead me to hope that further study may throw important light on the cause of the production of secondary crystalline forms.

In preparing the specimens, so much of the substance must be added to the borax that it entirely dissolves at a high temperature, but is partially deposited when kept for some time at a heat below dull redness. The beads should be about ¼ inch in diameter, and one-third that thickness. The loop in the platinum wire can easily be made circular by bending it round a glass rod. I need scarcely say that no one ought to expect to obtain good specimens at first. Much depends on that sort of manipulation which is easier to learn by experience than explain by writing.

The most useful object-glass is a 4-10 inch, of small aperture, made to adjust for looking through thick glass, so that crystals may be distinctly seen in the interior of the beads. When no condenser is used, the double convex form of the beads prevents our seeing more than a small portion of the interior; but by using as a condenser a plano-convex lens, of about ¼ inch diameter and ½ inch focal length, nearly the whole bead is illuminated, without the definition being materially injured; and even this may be overcome by properly regulating the distance of the condenser, and the size of the aperture below it. The full beauty of the specimens can only be seen with a binocular microscope, and few objects are better fitted to show the advantage of that kind of instrument. The crystals then stand out in perfect relief, and are seen to be equally complicated in all directions. It must not be thought that in each case all the crystals are alike. Those formed on the surface differ much from those in the interior of the beads; and in both positions, though the type is constant, the forms vary very considerably.

After having obtained crystals of satisfactory character, if it be desirable to keep the specimen as a permanent object, the ring-shaped loop and inclosed bead should be cut off and mounted in a cell with Canada balsam. This is requisite, since the moisture of the atmosphere causes the borax to become hydrated and opaque; but, when properly mounted in balsam, it alters so slowly that I have not remarked any change for half a year. When thus mounted, the curved form of the beads almost ceases to be any impediment in examining crystals in the interior, and an ordinary achromatic condenser of long focal length may be used with advantage; but in some cases crystals on the surface are much less distinct than when the beads are not mounted.

Few objects of the kind are more easily prepared than the crystals of borate of magnesia deposited from borax saturated with magnesia. They first form as thin prisms, and smaller crystals are afterwards deposited, so as to give rise to objects very much like a handle with a brush at each end.

Zircon or zirconia fused with borax yields crystals of the borate. In their most rudimentary state they are small prisms with a simple cross at each end, which afterwards becomes complicated.

The crystals of molybdate of zirconia formed by fusing zirconia in borax with molybdic acid, are extremely elegant and beautiful objects. They are so delicate that their own weight would probably break them, if they were in an aqueous solution; but being supported in solid borax, like the insects inclosed in amber, they are secure from all injury.

Scheelite—native tunsgate of lime—fused in borax is deposited in crystals of great beauty, and is an object easily prepared.

The molybdate of strontia, produced by fusing strontia and molybdic acid in borax, crystallises in long spindle-shaped crystals, whereas the molybdate of lime yields very different crystals, of a form intermediate between that of molybdate of zirconia and scheelite.

Apatite—native phosphate of lime—fused with borax, deposits in crystals which vary much in shape. Six-sided stars are often formed on the surface, and needle-shaped crystals grow from their centres into the interior of the borax, so that they look like nails with highly-ornamental heads driven down into the bead. When formed with their axis parallel to the surface, the crystals are sometimes much like *diatomaceæ*. The addition of phosphate of soda to a borax bead containing lime in almost any state of combination gives rise to similar crystals.

On adding a certain amount of carbonate of soda to quartz or various silicates dissolved in borax, crystals are deposited, which vary much according to circumstances; but they all seem to be due to the variable growth of many small six-sided prisms with expanded ends. Sometimes they have a curious dice-box form, resulting from a bundle of such crystals. Probably such are some silicate of soda, modified by the presence of other bases.

Titanic acid gives hair-like prisms variously grouped. Molybdic acid is sometimes set free as liquid globules, which coalesce, rise to the surfuce, and afterwards solidify as small spheres.

These few examples will, at all events, serve to show that the crystals deposited in blowpipe beads are of considerable interest, merely as beautiful microscopical objects. I should, however, be very sorry if any one were to imagine that I considered this their chief merit. On another occasion my aim will be to prove that this method may be employed with great advantage in determining the nature of minerals and chemical precipipates, when so small a quantity can be procured that other methods would almost or entirely fail to give satisfactory results.—*Monthly Microscopical Journal.*

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

July 1st, 1869.

Dr. A. W. WILLIAMSON, F.R.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The PRESIDENT stated that, as the meeting was an extraordinary one, the routine business would be dispensed with.

A written communication from Dr. Mills, on the subject of "*The Atomic Theory*," was read. No discussion followed, but the President said he should feel honoured if, after seeing in print what he himself had put together on the subject, they thought it worth while to go into the question some evening.

A paper by Mr. H. Smith, F.C.S., "*On Ethyl Hyposulphurous Acid*," was then read.

The author prepared ethylic sulphide by placing protosulphide of potassium in a retort with ordinary alcohol, passing the vapour of ethylic chloride into the liquid, and then applying heat, when a distillate, containing ethylic sulphide, alcohol, and ethylic chloride, came over. Water was added, and the oil which separated re-distilled. After rectification with calcium chloride, it had a constant boiling point at 81° C.

Ethylic sulphide was treated with an equal bulk of strong sulphuric acid, a large quantity of water added, and the whole neutralised with pure barium carbonate, the resulting solution of barium ethy-hyposulphite evaporated to one-third of its bulk, and set aside to crystallise. The author has also prepared the copper, silver, and sodium salts.

The PRESIDENT remarked that, according to the formula given by Mr. Smith, half of the metal of ordinary hypo-

sulphites was replaced by ethyl, and it was merely analogous in its constitution to a sulphate. It did not, as far as he could see, bear in any direct way on the question of the constitution of the hyposulphites, which occupied their attention a few meetings since.

Mr. PERKIN wrote the following formula on the board:—Barium salt—$(C_2H_5)_2BaS_4O_6+2H_2O$. The sodium salt would, therefore, be:—$C_2H_5NaS_2O_3+H_2O$.

The PRESIDENT remarked that the constitutional water was still undisturbed.

A paper by Dr. Phipson, "*On the Absorption Spectra of Certain Organic Substances*," was then read. The author had found that cyanine gave an absorption spectra resembling that of mauve. He also found that the colours of certain flowers gave absorption bands in the spectrum.

Mr. MCLEOD then explained "*An Apparatus for the Determination of Gases Dissolved in Natural Waters.*" The water is measured in a graduated pipette into which it is introduced without coming in contact with air, mercury being drawn from the bottom of the pipette, while a narrow tube connected with the upper part of the measure is passed to the bottom of the bottle containing the water. The water is then allowed to flow into the lower of two globes connected by a narrow glass tube, and in which a Torricellian vacuum has been produced. The lower globe stands in a water-bath heated to 50°, and the water is allowed to remain at that temperature for about 30 minutes. During this time almost the whole quantities of the nitrogen and oxygen dissolved in the water are evolved together with some carbonic anhydride. Mercury is then allowed to rise from a reservoir into the bulbs, and the gas, which has been evolved, removed by means of a Sprengel's mercurial pump, through a stop-cock at the top of the upper globe. After this, the mercury is run out from the globes and the water-bath more strongly heated, a slow current of cold water being allowed to trickle over the upper bulb. By this means the water is distilled *in vacuo*, and the gases remaining, which consist almost exclusively of carbonic anhydride, are eliminated from the water. These gases are then removed, as before, from the apparatus, by means of the Sprengel and analysed.

It was found necessary to resort to the process of distillation in order to decompose the soluble acid calcic carbonate; as some of this compound remained unaltered, even when maintained for two hours at a temperature of 105°—109° in a salt water bath. The following results were obtained from 100 c.c. of a sample of tap water drawn from the cistern of the Royal College of Chemistry.

I.

	Gas evolved at 50°.	Gas evolved on distillation.	Total.
	c.c.	c.c.	c.c.
N	1·3906	0·0067	1·3973
O	0·6093	0·0113	0·6206
CO_2	0·4199	3·8769	4·2968
	2·4198	3·8949	6·3147

II.

	Gas evolved at 50°.	Gas evolved on distillation.	Total.
	c.c.	c.c.	c.c.
N	1·3956	0·0022	1·3978
O	0·6057	0·0135	0·6192
CO_2	0·4990	3·6809	4·1799
	2·5003	3·6966	6·1969

The mercurial pump employed in these experiments is slightly modified from that originally described by Dr. Sprengel, in the *Journal of the Chemical Society*, though in the three experiments which have been tried, the results have not nearly equalled those described in his paper. Dr. Sprengel obtained a residue of air in an exhausted receiver equal to 1·1,300,000th of the original quantity: the best result obtained in the above-mentioned experiments being only 1·516,666th. By means of this apparatus, however, Dr. Frankland and Mr. Lockyer have rarefied perfectly dry oxygen, nitrogen, and hydrogen to such an extent, that their resistance was equal to that of atmospheric air at the ordinary pressure. The quantity of carbonic anhydride in carbonates may be determined in the form of gas, as first suggested by Dr. Russell, the Sprengel being employed for removing the gas from the valve in which the carbonates are decomposed. For this purpose a weighed quantity of the carbonate is placed in a small glass tube, which is then introduced into a wide perpendicular tube about 900 m.m. in length, and provided with a stop-cock at the upper end. The lower orifice is placed under mercury, and the air removed by means of the Sprengel. Dilute sulphuric or hydrochloric acid is passed up the tube, and the carbonic anhydride which is evolved removed and measured. In two experiments, the quantities of carbonic anhydride evolved from white marble were 43·72 and 43·61 per cent.

"*A New Form of Apparatus for Gas Analysis.*"—This is a modification of the apparatus described some years ago by Dr. Frankland and Mr. Ward. It consists of two tubes, one about 5 and the other about 20 m.m. in diameter. These tubes are, respectively 1100 and 900 m.m. long. They are surrounded by a cylinder, through which a constant stream of water flows, and communicate with one another, just below the wide cylinder, by means of a caoutchouc joint surrounded by calico. The lower end of the narrow tube is also connected, in a similar manner, with a tube provided with a stop-cock, and which descends 900 m.m. below the joint, and communicates, by means of a long flexible tube surrounded with calico, to a reservoir containing mercury, which is so suspended that it can be raised above the level of the top of the apparatus. The narrower tube is graduated in millimetres from the bottom to the top, the upper end being closed by a glass stop-cock. The wide tube is marked with divisions at every 100 m.m., the contents of each division being determined. This tube is provided with wires, and closed at the upper end by a capillary tube and glass stop-cock, with a steel cap, by means of which it may be attached to a short and wide laboratory tube, such as is used in the apparatus described by Dr. Frankland in the *Journal of the Chemical Society*, 2nd series, vol. vi., p. 109. The analysis of gases is performed with this apparatus in the same manner as with the original one of Frankland and Ward, the measurements being made by determining the temperature and tension of fixed volumes of gas. The absorptions are performed in the laboratory tube, and explosions in the measuring tube. The whole apparatus may be easily worked with 900 c.c. of mercury, and the results obtained are very satisfactory.

Dr. RUSSELL read a paper entitled. "*Further Experiments on the Atomic Weights of Cobalt and Nickel.*"

In 1863, the author published an account of researches on the determination of the atomic weights of cobalt and nickel by the reduction of the oxide by hydrogen, when he found the atomic weights of cobalt and nickel to be 29·37. Since then, experiments had been made by two other chemists, Sommannga and Winkler, the former of whom gave 29·99 for the atomic weight of cobalt, and 29·01 for nickel, while Winkler's determinations showed cobalt to be 29·49, and nickel, 29·53. More recently, Dr. Schneider, in a paper to *Poggendorff's Annalen*, called attention to the fact that Sommannga's determination of the atomic weights almost coincided with the numbers he had previously obtained, and endeavoured to explain why Dr. Russell's numbers differed from his own. The author had lately experimented with the same cobalt and nickel used before, and determined the atomic weights from the volume of hydrogen evolved when a known weight of the metal was dissolved in hydrochloric acid, and the results fully confirmed the accuracy of his former experiments. The mean of four experiments by the reduction of the oxides determined the atomic weights of both nickel and cobalt

to be 29·37; the mean of four experiments from the volume of hydrogen evolved was 29·38 for each metal.

The PRESIDENT thought it a most admirable confirmation of the conclusion arrived at by different methods, that numbers so very nearly coincident with these should be obtained by this process, and it was satisfactory that the result was established by concurrent evidence of very different kinds.

Professor WANKLYN said that the experiments related by Dr. Russell were particularly interesting to him, as they confirmed the views expressed by himself and Mr. Chapman about the hydrogen process.

After a verbal communication "*On the Action of Phosphoric Chloride on Oil of Vitriol*," by the Rev. Mr. WILLIAMS, the meeting was adjourned till the next session.

CORRESPONDENCE.

GASEOUS SPECTRA.

To the Editor of the Chemical News.

SIR,—In the paper on "Researches on Gaseous Spectra in relation to the Physical Constitution of the Sun, Stars, and Nebulæ," by Dr. Frankland and Mr. Lockyer, as reported by you, the authors do not notice similar observations which I presented to the Royal Society in April, 1868. I send you the following extracts from that paper, which is printed in the *Phil. Trans.* for 1868.—I am, &c.,

WILLIAM HUGGINS.

"The following observations are suggestive in connexion with the point under consideration. Electrodes of platinum were placed before the object-glass in the direction of a diameter, so that the spark was as nearly as possible before the centre of the lens. The spark was taken in air. I expected to find the spectrum faint, for the reasons which have been stated in a previous paragraph (the diminution of the brightness of the spark from the distance at which it is placed from the slit), but I was surprised to find that only one line was visible in the large spectroscope when adapted to the eye-end of the telescope. This line was the one which agrees in position with the line in the nebula, so that under these circumstances the spectrum of nitrogen appeared precisely similar to the spectra of those nebulæ, of which the light is apparently monochromatic. This resemblance was made more complete by the faintness of the line; from which cause it appeared much narrower, and the separate existence of its two components could no longer be detected. When this line was observed simultaneously with that in the nebula, it was found to appear but a very little broader than that line. When the battery circuit was completed, the line from the spark coincided so accurately in position with the nebular line, that the effect to the eye was as if a sudden increase of brightness in the line of the nebula had taken place. In order to make this observation, and to compare the relative appearance of the lines, the telescope was moved so that the light from the nebula occupied the lower half only of the slit. The line of the spark was now seen to be a very little broader than the line of the nebula, and appeared as a continuation of it in an unbroken straight line. These observations were repeated many times on several nights."—(P. 542.)

"The double line in the nitrogen-spectrum does not consist of sharply defined lines, but each component is nebulous, and remains of a greater width than the image of the slit.* The breadth of these lines appears to be connected with the conditions of tension and of temperature of the gas. Plücker* states that when an induction-spark of great heating power is employed, the lines expand so as to unite and form an undivided band. Even when the duplicity exists, the eye ceases to have the power to distinguish the component lines, if the intensity of the light be greatly diminished.

"Though I have been unable to detect duplicity in the corresponding line in the nebula, it might possibly be found to be double if seen under more favourable conditions; I incline to the belief that it is not double.†

"In my tables of the lines of the air‡ I estimated the brightness of each of the components of the double line in the spectrum of nitrogen at 10, and the components of the double line next in brightness in the orange at 7 and 5, and those of a third double line on the less refrangible side of D at 6 and 4. It was with reference to these two double lines next in apparent brilliancy that I wrote,‖ in speaking of the line in the nebula, 'If, however, this line were due to nitrogen, we ought to see other lines as well; for there are specially two strong double lines in the spectrum of nitrogen, one at least of which, if they existed in the light of the nebulæ, would be easily visible.'

"As the disappearance of the whole spectrum of nitrogen, with the exception of the one double line, was unexpected, though, indeed, in accordance with my previous estimations, I examined the spectrum of nitrogen with a spectroscope furnished with one prism with a refracting angle of 60°, in which the whole of the spectrum from C to G is included in the field of view. I then moved between the eye and the little telescope of the spectroscope a wedge of neutral-tint glass corrected for refraction by an inverted similar wedge of crown glass, and which I had found to be sensibly equal in absorbing power on the different parts of the visible spectrum. As the darker part of the wedge was brought before the eye, the two groups in the orange were quite extinguished, while the lines in the green still remained of considerable brightness. The line which under these circumstances remained longest visible next to the brightest line, was one more refrangible at 2669 of the scale of my map. This observation was made with a narrow slit. When the induction spark was looked at from a distance of some feet with a direct-vision prism held close to the eye, I was surprised to observe that the double line in the orange appeared to me to be the brightest in the spectrum, and when the neutral-tint wedge was interposed, this line in the orange remained alone visible, all the other lines being extinguished.

"When, however, in place of the simple prism a small direct-vision spectroscope provided with a slit was employed, I found it to be possible, by receding from the spark, to find a position in which the double line in the green, with which the line in the nebula coincides, was alone visible, and the spectrum of the spark in nitrogen resembled that of a monochromatic nebula.

"It is obvious that if the spectrum of hydrogen were reduced in intensity, the line in the blue, which corresponds to that in the nebula, would remain visible after the line in the red and the lines more refrangible than F had become too feeble to affect the eye.

"It therefore becomes a question of much interest whether the one, two, three, or four lines seen in the spectra of these nebulæ represent the whole of the light emitted by these bodies, or whether these lines are the strongest lines only of their spectra which, by reason of their greater intensity, have succeeded in reaching the earth. Since these nebulæ are bodies which have a sensible diameter, and in all probability present a continuous luminous surface, or nearly so, we cannot suppose that any lines have been extinguished by the effect of the distance of these objects from us.

* Secchi states that with his direct spectroscope this line in the annular nebula in Lyra appears double. As the image of the nebula is viewed directly, after elongation by the cylindrical lens, and without a slit, it is probable that the two lines may correspond to the two sides of the elongated annulus of the nebula.

* *Philosophical Transactions*, 1863, p. 13.

† "On the Spectra of the Chemical Elements," *Philosophical Transactions*, 1864, p. 141.

‡ Ibid.

‖ Ibid, p. 443

"If we had evidence that the other lines which present themselves in the spectra of nitrogen and hydrogen were quenched on their way to us we should have to consider their disappearance as an indication of a power of extinction residing in cosmical space, similar to that which was suggested from theoretical considerations by Cheseaux, and was afterwards supported on other grounds by Olbers and the elder Struve. Further, as the lines which we see in the nebulæ are precisely those which experiment shows would longest resist extinction, at least so far as respects their power of producing an impression on our visual organs, we might conclude that this absorptive property of space is not *elective* in its action on light, but is of the character of a *general* absorption acting equally, or nearly so, on light of every degree of refrangibility. Whatever may be the true state of the case, the result of this re-examination of the spectrum of this nebula appears to give increased probability to the suggestion that followed from my former observations, namely, that the substances hydrogen and nitrogen are the principle constituents of the nebulæ of the class under consideration."—(Pp. 543—544.)

MISCELLANEOUS.

Royal School of Mines.—At a meeting of the Council on Saturday, the 3rd inst., the results of the examinations for the past session were declared. The following gentlemen, having passed the requisite examinations, have obtained the title of "Associate of the Royal School of Mines" in the divisions mentioned:—Bell, Metallurgical; G. Broome, Mining and Metallurgical; L. Brown, Metallurgical; — Butler, Geological; R. J. Frecheville, Metallurgical; G. Green, Metallurgical and Geological; M. F. Maury, Mining and Metallurgical; F. J. M. Page, Mining and Metallurgical; — Tayler, Metallurgical. The following prizes and scholarships were awarded:—Two Royal Exhibitions of £15 for first year students—(1) J. J. Bowrey; (2) W. Gowland. H.R.H. The Duke of Cornwall's Scholarship, £30 for two years—W. J. Sollas. Royal Exhibition of £25 for second year students—W. Gowland. De la Beche Medal and Books, for Mining—G. Broome. The Director's (Sir Rod. I. Murchison's) prize for Geology—W. Gowland.

Inexhaustible Manures.—In the Atlantic Ocean, a little to the west of the Azores, there exists a space seven times larger than all Germany, according to the late A. von Humboldt, completely covered with a dense mass of vegetation, the so-called Sargasso Sea. M. J. Lavinière has proposed to the Société d'Agriculture to make these floating meadows, as they are called by Aviedo, subservient to the purposes of agriculture. His suggestion is that the ships occupied during the summer in cod-fishing should, in other seasons, be employed in conveying this abundant and excellent manure to the Azores, where an *entrepôt* could be established, the weeds pressed and dried, and the salts they contain extracted. Analysis has shown that these weeds possess the same fertilising properties as those employed as manure on the French coasts. M. Lavinière calculates that these floating meadows produce annually sufficient vegetable matter to manure 150,000,000 hectares, a hectare being about an acre and a half.—*Revista Industrial, &c.*

Pink Colour and Mineral Lake.—Under the name of pink colour there is met with in the trade, and manufactured by a process which is kept secret, a substance which is chiefly used in this country for painting faience and porcelain. According to M. Malaguti's analysis, this substance is composed, in 100 parts, of—Peroxide of tin, or stannic acid, 78·31; lime, 14·91; silica, 3·90; alumina, 0·05; oxide of chromium, 0·52; chromate of potassa, 0·20; potassa and loss, 0·48. The stannic acid, lime, and oxide of chromium are the essential elements; the silica and alumina are not indispensable; the richness and depth of the colour depends upon the larger quantity of lime and chromate applied in the manufacture. According to M. Gentele, this pink colour may be prepared in the following manner:—1 kilo. of granulated tin is oxidised with nitric acid, the meta-stannic acid thus obtained is mixed with 150 grms. of bichromate of potassa dissolved in 1 litre of water, and to this mixture there are added 2 kilos. of chalk and 1 kilo. of finely pulverised glass-sand; these materials are made into a paste, and strongly ignited, after having been placed in a crucible, to a bright red heat; the result of this calcination is ground to an impalpably fine powder, and again ignited, with the addition of carbonate of soda. When a mixture of 100 parts of stannic acid and 2 parts of oxide of chromium is ignited to a bright red heat a beautiful lilac-coloured material is obtained, which is neither injured by daylight nor atmospheric influences, resists the action of sulphuretted hydrogen, and is called by M. Malaguti "mineral lake."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences (No. 26), June 28, 1869.

We observe, in the first place, that Sir Roderick Murchison was present at this meeting of the illustrious scientific society of France, of which he has been elected a Foreign Member; being present for the first time after his election, he was most heartily received by the large number of *savants* present. The speech made by the celebrated British geologist was the signal for M. Dumas to say a few words, highly eulogising the excellent reception given to him while lately at London, and stating that, in the person of one of their perpetual secretaries, the British scientific world and renowned *savants* had honoured and feted the Academy. We notice the following papers:—

Mode of Condensing Magnetism Analogous to the Condensation of Electricity.—M. Jamin.—The author has caused M. Limet to make for him a horseshoe-shaped magnet, made up of ten bars of perfectly homogeneous steel, and fastened together by means of bolts. When this artificial magnet is properly magnetised, it is capable of bearing a weight of 300 kilos. at the armatures. When this armature is placed so as to be only in contact with one of the steel bars composing the horseshoe, it appears that the magnetism of the nine other bars is very perceptibly diminished. Under these conditions, and, notwithstanding the magnet was previously already saturated with magnetism, it is possible to saturate anew with magnetism, and make the horseshoe bear again 600 kilos. This experiment can be repeated: another armature may be put on, so as to bear only upon one of the component bars, and, again, more magnetism can be condensed. The learned author has already succeeded in making the horseshoe bear another 680 kilos. in this manner.

Researches on the Oxygenated Bases—Action of Chlorhydric Glycol on Toluidine.—M. Wurtz.—This is another instalment of the papers resulting from the author's labours on this subject. The paper here alluded to contains researches on the action of chlorhydric glycol upon aniline and toluidine. When a mixture of aniline and chlorhydric glycol are heated together on a water-bath, a thickish and coloured liquid is obtained, which yields, with a concentrated solution of chloride of platinum, a very unstable, readily-decomposable salt. When the mixture of substances just alluded to is heated in an air-bath to from 195° to 210°, and the fluid afterwards treated with water, and filtered, an abundant precipitate is formed with a concentrated solution of chloride of platinum. This salt, having been well purified, yields, on analysis, results leading to the formula—

$$(C_{14}H_{18}ON.Cl)_2,PtCl_4.$$

When toluidine is thus acted upon by chlorhydric glycol, the author obtains three bases—(*a*) vinyltoluidine—

$$C_9H_{11}N = \left.\begin{matrix} C_7H_7 \\ C_2H_3 \\ H \end{matrix}\right\} N;$$

(*b*) two other bases of complex composition, containing no longer toluyl, but the radical C_7H_8, toluenyl; while one of these bases contains, besides toluenyl, also two vinylic groups.

New Researches on Hydrogenium.—Mr. T. Graham.—From this paper we quote, in the first place, that the author finds the specific gravity of hydrogenium to be 0·872. The eminent *savant* records in this paper, consecutively, researches on—*palladium, platinum, and hydrogenium; palladium, gold, and hydrogenium; palladium, silver and hydrogenium; palladium, nickel, and hydrogenium.* We give these researches in a separate paper on another page.

Poisonous Effects of Coralline.—M. Landrin.—This paper, or report, rather, contains the results of the researches made at the request of the celebrated Dr. Tardieu, and the members of the Academy of Medicine. The result of carefully-made experiments, also by giving large doses of coralline to animals and applying it to their skin, is that coralline is no poison at all, whether internally or externally applied; and its use in dycing is quite harmless, provided it be not mixed with substances which are very decided poisons.

Certain Stellar Spectra.—M. Janssen, in a letter dated from Darjeeling, Sikim, British India, 22nd May last, says that the spectra of some stars, which are rather ruddy-coloured when not disclosing the presence of hydrogen, do positively disclose the presence of aqueous vapour.

Spectra which some Compound Substances Exhibit when Produced within Gaseous Mixtures which are in a state of Equilibrium.—Messrs. Berthelot and Richenau.—This paper is not suited for proper abstraction.

Presence of Peroxide of Hydrogen in the Atmosphere.—M. Struve.—The author, writing from Tiflis (a large town on the Caucasian side of Russia), calls attention to some interesting facts observed by him in reference to the quantity of nitrite of ammonia, ozone, and oxygenated water (peroxide of hydrogen) present in rain-water, and water obtained from melting snow and hail. The author applies oxide of lead as a test, which is converted into peroxide. M. Sainte-Claire Deville reminded the meeting that, while—in July and August, 1859—he was engaged in making some researches (he was, during that time, staying on the St. Bernard); on ascending two mountain tops, named Le Vélan and Le Combin, respectively 3762 and 4430 metres high, he collected there rain and snow water, which, on being analysed by M. Boussingault, was found to contain so much ammonia and nitric acid that, were it not that several bottles of the same sample were taken, it might have appeared as if bottles which were not well cleaned had been applied for collecting the fluids.

Heat of Combination of Hydrosulphuric and Hydroselenic Acids.—M. Hautefeuille.—This paper is too abstruse for condensation.

Theory of Etherification by means of Hydrochloric Acid.—M. Friedel.—When it is desired to obtain a compound ether, the mode of obtaining it often resorted to is, to mix the acid of which it is desired to have the ether with alcohol, and to pass through this mixture a current of hydrochloric acid gas. The author proves that, in that case, there is formed first a chloride of the acid radical, and that that chloride afterwards gives rise to the formation of the compound ether. The author describes at length a process whereby it is possible to obtain, by the action of hydrochloric acid gas upon benzoic acid, chloride of benzoyl.

Primitive Normal Butylic Alcohol.—Messrs. Lieben and Rossi.—This lengthy paper contains the results of experiments made by the authors to prove that a compound discovered and described by M. Wurtz as a butylic alcohol, in the year 1850, is only an isomer of the true and genuine butylic alcohol obtained in a peculiar manner, described at great length by the authors, and wherein an aldehyde plays an important part. We conclude these abstracts by simply quoting the titles of the following papers, which are either purely physical, or are not well suited for proper abstraction with due justice to their contents, and the labours bestowed thereupon by their authors:—

Compressibility of Liquids.—Messrs. Amaury and Descamps.

Measure for the Conductive Power for Electricity of such Fluids as are Generally Hitherto considered as Non-Conductors.—M. Said Effendi.

Alcoholic Fermentation Excited by the Microzymas of the Liver.—M. Béchamp.

Toluylen-Diamine.—M. G. Koch.—

Researches on Inuline and the Acetic Acid Derivatives therefrom.—Messrs. Ferrouillat and Savigny.

Deutsche Industrie Zeitung, May 24, 1869.

Detection of Arsenical Pigments.—M. C. Puscher states—That during the first five months of this year, no less than eight cases of accidental poisoning by these pigments have occurred at Nürenberg; he advises the use of liquid ammonia for the detection of these pigments, all of which, he says, are soluble therein, exhibiting a blue coloured solution, if copper is at the same time present; he further states that, on the evaporation of the ammonia, there remains a dirty greenish coloured precipitate of arsenite of oxide of copper; his advice is to paint some *white* paper with this solution in ammonia, which painting, when dry, if arsenic were present, will exhibit a dirty greenish colour, but if after drying a blue colour appears to have been imparted to the paper, the pigment is quite free from arsenic, and only consists of a compound of copper, of which latter metal there are several in use, as green and blue pigments, all soluble in ammonia, except such adulterations as do not essentially belong to the pigment itself.

The Journal of the Franklin Institute (No. 4), April, 1869.

We notice from this paper the following communications and papers:—

Spectrum Lines, a New Method of Illustrating them.—At a late meeting of the American Institute, Professor E. C. Pickering, of the Massachussetts Institute of Technology, employed the following method to illustrate his paper on spectrum analysis. A sheet of black lace, 1¼ ft. broad, and 3 ft. high, was suspended as a screen, and upon it was thrown a continuous spectrum from a magnesium light, arranged in the manner first developed for electric light by Professor Cooke, of Cambridge, U.S., except that only one bisulphide of carbon prism was used. The spectrum covered the entire lace screen, the curvature of its lines being corrected by an opposite curvature of the opening through which the light passed. Upon this black lace were attached a number of strips of white paper, so arranged as to occupy the places of the bright lines in seven different spectra, such as those of sodium, potassium, rubidium, cæsium, &c. These being illuminated by the variegated light of the continuous and broad spectrum, received and reflected each colour corresponding to its position, and, therefore (their adjustment being accurate), that which actually belonged to the band which it represented. The light falling between these paper bands was, of course, not reflected, and the appearance, therefore, was in each case (as in an actual spectrum) that of bright-coloured lines on a dark ground. When, however, as in the case of potassium, the nebula of Orion, &c., a faint continuous spectrum is, in fact, combined with that of the bright lines, this, also, was represented by attaching, in the required places, bands of white lace, which reflected enough of the coloured light to produce a hazy spectrum, admirably imitating that of the substances or bodies in question.

Acid-Proof Cement.—R. F. Fairthorne.—It frequently happens that the chemist requires some means for protecting cork from the destructive action of vapours such as arise from boiling nitric acid; the author found the following plan to meet this requirement:—Finding it necessary to connect a glass tube with a wide-mouthed flask, and, in so doing, to use a cork, which was exposed to the action of the fumes from boiling nitric acid for several hours, the author found the best preservative to consist of a coating of silicate of soda and powdered glass. The cork, having been bored to suit the size of the tube, was soaked for two or three hours in a solution of silicate of soda, consisting of one part of commercial concentrated solution to three parts of water. The tube was next inserted, and, when dry, the cork was covered with a paste, made by mixing the concentrated solution of the silicate with powdered glass, in such proportions as to form a mass of about the same consistence as that of putty. This is spread on the under surface, and then washed with a solution of chloride of calcium. It soon hardens; so that it is advisable to make the connection with the flask whilst the paste is in a plastic state, and to allow it to become solid before applying heat to the vessel containing the acid. Corks protected in this manner were but slightly acted upon after remaining over the boiling nitric acid more than four hours, and over hot acid for ten. The cement, the preparation and use of which is herein described, is very useful for general use as a luting for chemical apparatus.

Hot-Cast Porcelain.—Charles P. Williams.—This is the trade name of a peculiar tough, milk-white, translucent glass, not unlike French porcelain in appearance, and extensively made at Philadelphia and Pittsburg, U.S. It is intermediate in character between the glasses produced by the addition of phosphate of lime to the ordinary glass materials, on the one hand, and the white enamels, such as are produced by oxide of tin on the other, having more of the milkiness than the former and less opacity than the latter. The raw materials consumed in its production are sand, oxide of zinc, and cryolite, which are melted together in the ordinary clay pots of the glass maker. The following is the composition of an average sample of this glass, taken when the "metal" was in its best working condition:—Silica, 63·84; alumina, 7·86; peroxide of iron, 1·50; protoxide of manganese, 1·12; oxide of zinc, 6·99; lime, 1·86; magnesia, 0·25; soda, 10·51; fluorine, 8·05; [less oxygen (corresponding to the fluorine), 3·39] = 98·59 for 100 parts. The above is the mean of five analyses. The method pursued in the above analyses consisted in fusing the compound with carbonate of soda, extracting with water, and, after precipitating the silica and alumina in the aqueous solution by means of carbonate of ammonia, separating the fluorine as fluoride of calcium mixed with carbonate of lime, by the addition of chloride of calcium. The mixed salts were afterwards treated with acetic acid, and the separated fluoride of calcium, dried, burned, and weighed. The remainder of the analysis was conducted as is usual in the analysis of silicates, the alumina and oxide of iron being precipitated as basic acetates, and separated, after weighing, by means of tartaric acid and sulphide of ammonium. Admitting the fluorine to exist in the glass in the condition of silico-fluoride of sodium (NaF,SiF_4), the following formula will express the composition of the compound:—

$$2[R_2O_{8}3SiO_2+3(RO_3SiO_2)]+NaFSiF_3.$$

Zeitschrift für Chemie, von Beilstein, No. 9, 1869.

The original papers contained in this periodical are—

Monochlorocrotonic Acid and its Salts.—M. O. Froelich.—When two parts by bulk of perchloride of phosphorus act upon one part, by bulk, of ethyldiacetic acid, two new acids containing chlorine are formed; both are crystalline, and they are isomeric with each other; only one of these acids, the monochloroacetic acid,

$$C_4H_5ClO_2, (C = 12, O = 16),$$

has been further investigated; the pure acid is a solid substance, exhibiting crystalline structure, fusing at 59° C.; becoming solid again at 55° C.; boils at 194·8° C.; it is a rather volatile substance, prone even to sublime when kept in closed bottles at the ordinary temperature of the air. It is not very soluble in water; at 7° C. one part of the acid requires 70 parts of water for solution; readily soluble in ether and alcohol. It is a rather powerful acid, easily decomposing carbonates. The author has prepared a series of salts of this acid with alkaline, earthy, and metallic bases: the potassa salt, $C_4H_4ClO_2,K+H_2O$, is crystalline, like almost all of the salts this acid forms. Monochlorocrotonic acid-ethyl ether, $C_4H_4ClO_2(C_2H_5)$, is a colourless, oily fluid, possessing an aromatic odour and a cooling taste, boils at 161·4° C. Its specific gravity at 15° C. is 1·113. Slightly soluble in water, readily in alcohol and ether; does not affect the vegetable colours, as, for instance, litmus. The methyl-ether analogous with the preceding—

$$C_4H_4ClO_2(CH_3)$$

is an oily fluid boiling at 142°; its specific gravity at 15° is 1·143. Insoluble in water, less soluble in alcohol than the preceding.

Presence of Peroxide of Hydrogen in the Atmosphere.—M. H. Struve.—The author, writing from Tiflis, Central Russia, states that his observations and researches of the water of the river Kurr, after a heavy rain or snowstorm, led him to detect therein first, ozone, next peroxide of hydrogen, and afterwards nitrite of ammonia. In

order to detect peroxide of hydrogen in rain or snow-water, the author adds to 25 c.c. of water, 5 drops of a clear iodide of potassium and starch solution, and next a single drop of a solution of sulphate of protoxide of iron and ammonia. When only traces of HO_2 are present, a blue colouration soon ensues, but soon also disappears. The author has not made any quantitative researches, but he avers that, owing to the presence of HO_2 in the water obtained from snow and rain, at Tiflis at any rate, and in that portion of Europe, peroxide of hydrogen may be present.

On some Derivatives from Methylen.—M. Butlerow.—Chloride of methylen, CH_2Cl_2, was prepared from pure iodide of methylen, by passing a current of chlorine through it while placed in a distilling apparatus under water, and a long-continued purifying process; the chloride of methylen is a colourless, very mobile fluid, exhibiting a smell akin to that of chloroform, and like that endowed with a sweet, burning taste. Chloride of methylen is somewhat soluble in water; its specific gravity is at 0° C. 1·3604; it consists, in 100 parts, of—C, 14·12; H, 2·35; Cl, 83·53. Hexamethylenamin is the result of the action of oxymethylen and ammonia upon each other; this base yields with hydrochloric acid a crystalline compound, $C_6H_{12}N_4Cl$.

Bromated (Gebromtes) Toluidin.—When it is desired to prepare bromated aceto-toluidin, the latter substance is placed in a vessel and water is poured over it, and next bromine is added in small quantities at the time; the monobromated aceto-toluid, $C_7H_6BrN(C_2H_3O)H$, is a solid, crystalling in needle-shaped crystals, difficultly soluble in water, readily so in alcohol; fuses at 117·5° C.; bromated-toluidin is a colourless liquid, boiling at 220° C., insoluble in water; specific gravity 1·510 at 20° C. The nitrate of this last compound, $C_7H_6Br.NH_2.HNO_3$, is a beautifully crystalline substance, not readily soluble in water, fusible at 182° C., but at the same time becoming decomposed.

Action of Sulpho-Chloride upon the Bromide and the Iodide of Ethyl.—M. E. Wroblevsky.—SO_2HCl does not exert any action at all upon C_4H_9Br, until the heat of a water bath is applied; HBr and Br then escape. After dilution with water, neutralisation with $BaCO_3$, and a careful evaporation, the author obtained a salt, $(C_2H_5Br.SO_4)Ba$. SO_2HCl acts very energetically upon C_2H_5I, while, thereby, separation of HI and I takes place. When SO_3, anhydrous sulphuric acid, is made to act upon $C_2H_3Cl_3$, and the product was saturated with baryta, the barium salt was obtained of a very unstable chlorinated compound.

Series of Isomeric Derivatives from Toluol.—MM. Beilstein and Kuhlberg.—Paranitrotoluidin, $p.C_7H_6(NO_2)(NH_2)$, is prepared by the reduction of dinitrotoluol and hydrosulphide of ammonium; it exhibits a yellow-coloured crystalline mass, fuses at 77°, is soluble in hot, not so well in cold, water: the nitrate, hydrochlorate, and sulphate of this base are all crystalline substances. Nitrate of paradiazonitrotoluol, $p.C_7H_6(NO_2)N_2.NO_3$, is obtained by treating nitrate of paranitrotoluidin with nitrous acid. Of the long series of derivatives obtained, we only mention yet β nitrotoluol. $\beta C_7H_7(NO_2)$, is a liquid boiling at 222° C., having, at 25° C., a specific gravity of 1·163; is not acted upon by chromic acid.

Observations concerning the Essay of Frémy on Hydraulic Cement.—M. A. Schulatschenko.—The only matter of interest to our readers in this paper (which reviews all which has been stated and done from the year 1786, beginning with the celebrated Chaptal, up to the present day, as regards the hydraulic and other cements, especially in respect of the cause of the hardening under water as well as in air), is the analysis of a marl found on the borders of the river Wolchow, Russia, and applied to the manufacture of cement by careful burning. In 100 parts, this material contains—Carbonate of lime, 63·84; carbonate of magnesia, 5·78; peroxide of iron and alumina, 3·22; sulphate of lime, 0·32; water, 1·04; the remainder was insoluble in hydrochloric acid, and consisted of—Silica, 18·16; alumina, 2·02; peroxide of iron, 3·56; potassa and soda, 1·66; together, 99·60. This material yields, after burning, a product which, on being treated with water, becomes strongly heated, swells up and falls to powder, as does burnt limestone, but unlike it, the material alluded to hardens slowly under water; if, however, this marl happens to be more strongly burnt, exposed to more than a faint red heat, not visible in daytime, a product is obtained which does not, on coming into contact with water, act as just described, but which very rapidly sets and hardens under water. The author observes that we have to distinguish two kinds of cement—such as contain lime in a free state, the Roman cements of M. Winkler, and the hardening of which has been fully explained by Fuchs, and such cements which do not contain lime in a free state, the Portland cements of M. Winkler, the hardening of which is as yet not well explained. According to M. Rivot and others, the cause of the hardening is due to the binding of water by the silicates formed during the burning, while, according to Winkler and others, the effect of water and the cause of hardening is due to the splitting up of silicates into more simple silicates. It is a fact, however, that the action of lime upon Puzzolanes is not sufficiently great solely to explain the hardening of cements.

No. 10, June 8, 1869.

We learn from this number that a very flourishing Chemical Society has, with the permission of the Imperial Government, been established and recognised as one of the scientific institutions of the Russian Empire; the transactions of this society are to be published in the Russian language. The only original paper in the above-named periodical is the record of several researches made at St. Petersburg—

Isomeric Phenolsulpho-Acids and the Action of Chloride of Benzoyl on the Potassa Salt of that Acid.—M. Solomanoff.—according to the author's researches, there exist three isomeric phenolsulpho acids, all of which are simultaneously formed when sulphuric acid acts on phenol. The author distinguishes these acids by α, β, and γ, or by prefixing to the two first para and meta: the author prepared these acid in rather large quantities; the potassa salts of these acids are distinguished from each other by the following particulars: the α salt, $C_6H_5KSO_4$, crystallises in six-sided foliated crystals, is the most difficultly soluble of the three salts in water, fuses at 240° C; the β salt crystallises in needle-shaped crystals, and is capable of taking up variable quantities of water of crystallisation, varying from 1·01 per cent to nearly 15 per cent; it fuses at between 235° and 240° C, yielding a yellowish liquid; the γ salt contains from 16·28 to 17·51 per cent of water of crystallisation, does not, on being heated, melt until it just reaches 240° C. When α phenolsulpho-potassium is heated with chloride of benzoyl, hydrochloric acid is given off and benzoyl-phenolsulpho-potassium is obtained; this salt is soluble in water, and crystallises from its solutions therein in large needle-shaped crystals; the corresponding γ compound, after having been dried at 130° C, is composed according to the formula $C_6H_4(KSO_3)O(C_7H_5O)$; it is difficultly soluble in cold water, but readily in hot water; also soluble in warm alcohol.

Action of Chlorosulpho-Anhydride, $HClSO_3$, on Phenol and Phenolsulpho-Potassium.—MM. Engelhardt and Latschinoff.—The authors made some experiments in order to ascertain whether, when instead of sulphuric acid the compound SO_3HCl was made to act upon phenol, the result would be the formation of one acid only, or of three isomeric acids, as in the instance just previously alluded to; when to one equivalent of phenol, one equivalent of SO_3HCl is added, a very strong reaction takes place, the mixture becomes hot, hydrochloric acid is given off, a thickish red-coloured mass is obtained, from which, by gently heating, all hydrochloric acid was expelled; the mixture after having been formed into a potassium salt, this proved on analysis to be pure α or para phenolsulpho-potassium; the authors made experiments with divers proportions and quantities of SO_3HCl and phenol, and found as result chiefly the production of the acid of the salt just referred to.

Phenol Phosphosulpho-Acid.—M. Maikopar.—The author has studied the action of sulphuric anhydride upon phosphate of phenol, and also the action of phosphor oxychloride upon para phenolsulpho-potassium; the author describes at great length his researches: dry phenol phosphosulpho-barium, $(C_6H_4BaSO_3)_2PO_4$, gave in 100 parts—Baryta, 27·72; sulphuric acid, 29·84; and phosphorus, 4·03. When oxychloride of phosphorus was heated with dry para phenolsulpho-potassium a solid mass was obtained, on exhausting this with ether the latter left on evaporation an oil which was found to contain chlorine, phosphorus, and a substance belonging to the phenolsulpho-acid group; but the results of the analysis of this substance gave figures from which no definite formula could be deduced.

On Murrayin, a Newly-Discovered Glucoside.—Prof. Blas.—The author states that he received from Dr. de Vrij a quantity of murrayin, extracted by the latter gentleman from the *murraya exotica* during his sojourn in the East Indies; in pure state murrayin is a white coloured solid substance, exhibiting needle-shaped crystals, its taste is slightly bitter; it is difficultly soluble in cold water, and insoluble in ether, readily soluble in boiling water and in alcohol; these solutions are neutral to test paper. Murrayin fuses at 170° C.; is readily soluble in solutions of caustic and carbonated alkalies; these solutions exhibit a high degree of fluorescence, they appear yellow in direct light, greenish blue when the rays of sunlight are made to pass through the solutions; crystallised murrayin has the formula $C_{26}H_{44}O_{20}+H_2O$; when one part of murrayin is mixed with one part of strong sulphuric acid, and 25 parts of water, and this mixture heated in a sealed tube or in a flask, in an atmosphere of carbonic acid, the substance is split up, murrayetin and sugar being formed; this splitting up takes place according to the following formula:—

$$C_{26}H_{44}O_{20}+2H_2O = \underbrace{C_{24}H_{24}O_{10}}_{\text{Murrayetin.}}+2C_6H_{12}O_6.$$

Murrayetin is a solid substance, which readily crystallises; its concentrated solutions have a weak acid reaction; with perchloride of iron, it yields a beautiful blue colouration.

TO CORRESPONDENTS.

ERRATUM.—"G" sends the following corrections to the note "On the Employment of Constant Factors," in No. 498, p. 300:—Line 8, *for* 13 *read* :6; line 11, *for* 13 *read* 16; line 12, *for* 12 *read* K; line 13, *for* 39 *read* 39·2.

Biography of Dumas.—Dr. Muspratt informs us that his Biography of J. B. Dumas, M.D., was published in the *Lancet* in 1851, vol. 1, p. 248.

F. Caut.—This correspondent wishes to know what public institutions there are for the study of chemistry in Nottingham. Perhaps some of our correspondents can give the desired information.

BOOKS RECEIVED.

Sound; A course of Eight Lectures delivered at the Royal Institution of Great Britain. By John Tyndall, LL.D., F.R.S. Second edition. London: Longmans, Green, and Co.

What is Matter? By An Inner Templar. London: Wyman and Sons.

The Retrospect of Medicine. Edited by W. Braithwaite, M.D., and James Braithwaite, M.D. Vol. lix. London: Simpkin, Marshall, and Co.

The Quarterly Journal of Science.

popular Science Review.

THE CHEMICAL NEWS.

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ON

HEAT TREATED AS A SCIENCE OF KINETICS.*

By G. F. RODWELL, F.C.S.

(Continued from p. 16).

II. (ABSTRACT).

IN this lecture, some of the effects of heat upon matter were discussed, commencing with expansion, and the experiments which illustrate this part of the subject were shown (such as the unequal of a compound bar, S'Gravesande's ball, and the various appliances by which liquids and gases can be shown to expand, as the alcohol and mercury thermometer, Galileo's air thermometer, Leslie's differential air thermometer, and so on). The intensity of the attractive force exerted by similar molecules acting through an insensible space (cohesion) was shown by the breaking of a bar of iron by the contraction of a metal bar during cooling.

The following definitions are taken for the most part from the lecture notes:—

"*Æstus est commotio . . . omnis commotio fervorem gignit.*" Heat having been defined in the last lecture as a motion of the small particles, or molecules, of matter, it is obvious that the addition of this motion to a congeries of molecules must cause them to occupy a greater space (*expansion*); while the subtraction of this motion must cause them to occupy a less space than before (*contraction*).

In virtue of this, heat determines the form which matter assumes. In solids, the attraction of the molecules for each other (sometimes called *cohesion*, *from cohæreo*, to stick together), greatly predominates over the molecular motion, and, by limiting the range of movement, keeps them comparatively close together. In liquids, there is a greater amount of molecular motion; hence the range of movement of the molecules is extended; the cohesive force is lessened by the distance, and the molecules have a less restrained motion. In gases, there is a still greater amount of molecular motion: the molecules move at such a distance from each other that their individual attraction becomes a vanishing force; hence they are absolutely unrestrained in their motion. Thus, in the passage from solidity to gaseity, there is a progressive decrease of cohesive force, arising from a progressive augmentation of the space between the attracting molecules, and a progressive increase of molecular motion, arising from direct addition; while in the passage from gaseity to solidity, there is a progressive increase of cohesive force, arising from the diminution of the space between the attracting molecules, and a progressive decrease of molecular motion; arising from direct transference.

An increase of external pressure will obviously tend to approximate the molecules of matter; and hence, *à priori*, will, to some extent, produce the same result as a subtraction of molecular motion; while a decrease of external pressure will afford the molecules a greater range of movement, and will hence produce the same result as an addition of molecular motion. Thus certain gases are liquefied by increasing the pressure (for example, chlorine and sulphurous anhydride), and certain liquids are gasified by the removal of the existing pressure (for example, ethers having low boiling points, and, *à priori*, the liquids of gases liquefied by pressure).

We do not know the nature of the motion which constitutes heat. According to an hypothesis, which is ably supported, the molecules of solids and liquids move circularly around a centre, while the molecules of gases move in right lines. Thus a solid becomes liquid, in the language of this hypothesis, when the amplitude of the oscillation of its molecules passes a certain limit; and a liquid becomes a gas when its molecules fly off at a tangent to the circles in which they previously moved. This hypothesis is eminently Cartesian in its tone and character. (Examples of the passage of circular into tangential motion may be frequently observed—notably in the water which is projected from a trundled mop, in the sparks which fly off from a Catherine wheel, in the mud projected from the periphery of a rapidly-moving carriage wheel, and in a stone hurled from a sling. This last example is frequently adduced by Descartes (see his *Principia Philosophiæ*, pars. 2, cap. 39, entitled, "Altera lex naturæ, quod omnis motus ex se ipso sit rectus, et ideo quæ circulariter moventur, tendere semper ut recedant a centro circuli quem describunt;" and again, pars. 3, cap. 57 and 58). As a lecture experiment, it may be shown by attaching a small wooden ball to a spring (a helix of brass wire answers the purpose well), and communicating circular motion by whirling it in a vertical plane, either by the hand, or by a whirling table. As the velocity of revolution increases, (analogous to the increased molecular motion induced by heating), the ball recedes from the centre of revolution (analogous to the act of expansion), until, at a certain maximum of rapidity, the ball may be released, or may be caused to break the spring, when it of course assumes a rectilinear motion (analogous to the passage of a liquid into the gaseous condition); or the helix of brass wire may be replaced by a piece of india-rubber tubing, to one end of which the ball may be fastened by a movable pin, worked by a string, which passes through the axis of the tube and is held by the hand. The revolution is commenced, and, when at its maximum, the string is pulled so as to dislodge the pin, and thus release the ball, which immediately changes its circular for tangential movement; or, again, rapid circular motion may be communicated to a very shallow bowl containing water, and the velocity augmented until the particles of water fly off tangentially.

Heat is usually measured by the expansion of a liquid or gas, it having been found that equal additions of molecular motion produce, (*α*) in the case of gases, equal alterations in bulk, irrespective of the nature of the gas; (*β*) in the case of liquids, nearly equal alterations in bulk in the same liquid, although different alterations in different liquids. (*Thermometry*, θερμος, heat; μετρον, a measure).

A *degree of heat* is an arbitrary quantity, and it may be defined as the amount of molecular motion which is competent to increase the bulk of a certain quantity of specified matter to a certain known extent. A *unit of heat* was defined in the last lecture.

The *co-efficient of expansion* of a substance is the increase in length, (*linear co-efficient*), or in bulk, (*cubical co-efficient*), produced by the assumption of a certain amount of molecular motion, by a substance whose length or bulk was known when it possessed a certain less amount of molecular motion, in both cases measured as described above. Thus, if the length of a brass rod at the freezing point of water (32° F.) be taken as 1·000000, its length at the temperature of boiling water (212° F.) will be found to be 1·001867, and the linear co-efficient of expansion of brass for 212° − 32° F. = 180° F. is hence 0·001867, and for $1° F. = \frac{0·001867}{180} = 0·00001038$.

Evaporation (*evaporo*, to disperse in vapour), is the conversion of a liquid into gas at its exposed surface. The molecules at the surface, unlike those in the mass of the liquid, are influenced and restrained by the proximity of other molecules, *in one direction only*; hence, in the language of the hypothesis mentioned above, they more readily assume the rectilinear motion appertaining to the molecules of a gas.

Ebullition, or boiling, (*ebullio*, to boil or bubble up), is the conversion of a liquid into gas by the assumption of

* A course of four lectures delivered at the London Institution

rectilinear motion by the molecules in the interior of the liquid mass. The liquid continues to receive molecular motion until the cohesion of its molecules (plus or minus any of the extraneous actions mentioned below) is overcome; the molecules thus freed from restraint, part company with the liquid in the form of bubbles of gas. The temperature at which this takes place, subject to the conditions which at that time prevail, is called the *boiling point* of the liquid under those conditions.

The boiling point of a liquid is influenced by the following extraneous causes:—(α), external pressure, which, by limiting the motion of the molecules, and thus assisting cohesion, raises the boiling point; (β), the substance of the containing vessel, between which and the liquid molecules a certain attraction, differing for different substances, exist, which consequently assists cohesion, and raises the boiling point; (γ), dissolved substances, which in the case of dissolved solids tend to raise the boiling point, and in the case of dissolved air, to lower it. Thus water boils—(α) at a lower temperature on the summit of a mountain than at its base; (β) at a higher temperature in a glass than in a metal vessel; (γ) at a higher temperature when it contains salt in solution, as in sea water, than when it is free from dissolved solids, as in rain water; and at a far higher temperature when it is freed from dissolved air than when it contains air in solution.

Evaporation in the spheroidal condition is the surface evaporation of a liquid spheroid, floating upon a layer of its own gas, which separates it from direct contact with a surface possessing a higher (usually, but not necessarily, a much higher) temperature.

The spheroid has been proved to be out of contact with the hot surface by various means; thus the light of a flame can be seen through the space intervening between the spheroid and the hot surface, and nitric acid in the spheroidal condition upon a hot plate of copper does not attack it; neither does dilute sulphuric acid act upon zinc under the same conditions. We have analogous actions in the reverse experiment, in which a hot metal is caused to float upon a liquid surface, buoyed up by the layer of gas beneath. Thus, if a light silver ball be heated to whiteness, it will readily float upon the surface of water; and when iron is burned in oxygen, the globules of molten oxide will frequently float for a second or two upon the surface of the water beneath, or sometimes they will fall through a layer of one or two inches of water, and yet be sufficiently hot when they reach the bottom to fuse themselves into the glass or earthenware tray. Again, the freezing of water and mercury in red-hot vessels is due to the same action: liquid sulphurous acid evaporates comparatively slowly upon a white-hot surface, and when a mixture of solid carbonic acid and ether is poured into a red-hot platinum crucible, it immediately assumes the spheroidal condition, evaporates comparatively slowly, and will readily freeze mercury.

ANALYSIS OF THE WATER OF THE "ROYAL SULPHUR SPRING," HARROGATE.

By SHERIDAN MUSPRATT, M.D. (Hon.), F.R.S.Ed., M.R.I.A., &c.

THE water of this new spring has recently been introduced into the Royal Pump Room at Harrogate Wells, and, as it may prove an efficient *intermediate* one (*i.e.*, not so *strong* as the "Old Sulphur Well," *vide* my analyses, CHEMICAL NEWS, vol. viii., p. 155, and *stronger* than the "Magnesia Water," vol. viii., p. 195), I forward the results for publication in your valuable journal. Its characteristics, on reaching me (it was in a large stone jar, well sealed), were the annexed:—

An opaque appearance, owing to a separation of sulphur; a strong smell (this it does not evolve when drawn from the pump) of sulphide of hydrogen, which, collaterally with the milky shade of the liquid, indicated oxidation and decomposition of the sodic sulphide (NaS). On immediately filtering the water, the filtrate was perfectly clear and bright. During the analysis, &c., I found that, on boiling the water by direct heat, and likewise by the agency of steam, 1·986 grains per gallon of the sulphur were eliminated as gas (sulphide of hydrogen), the remaining portion withstanding the effects of both kinds of caloric. The water was alkaline, due to the earthy carbonates. The sulphur calculated as gas (sulphide of hydrogen) constituted 11·80 cubic inches per gallon. By prolonged exposure to atmospheric influences, the *whole* of the sulphur in the water deposited. It gave no organic matter, and only mere indications of ammonia, &c. The occurrence of the salts of barium, strontium, lithium in all the spas of Harrogate is very remarkable, for these compounds did not, and could not, exist in them twelve years ago, when my distinguished collaborateur, Dr. Hofmann, investigated them. Sulphates have disappeared from all of them. I do not consider that the presence of the chlorides of barium and strontium in any way enhances their medicinal properties; for, as soon as the water is imbibed, the chlorides become sulphates.

There can be no question, I think, that the additional ingredients are derived from the strata in the vicinity of Pately Bridge, nine miles west of Harrogate. All the strong spas contain barium and strontium; the Dr. Muspratt Chalybeate "chloride of iron" (FeCl) also. A recent analysis of it gives 16 grains of this latter salt in the gallon; so the amount is just the same as it was when I discovered its presence in 1865. The efficacy of this ferruginous compound in a potable water is now beyond a doubt; it is more easily assimilated than any other ferrous salt: Dr. Myrtle remarks—"I could fill volumes with cases benefitted or cured by its use."

College of Chemistry, Liverpool,
July 1st, 1869.

ON THE EXAMINATION OF WATER FOR ORGANIC MATTER.*

By R. ANGUS SMITH, Ph.D., F.R.S., &c.

(Continued from vol. xix., p. 306.)

Use of Permanganate of Potash, or Chameleon.

IT must be remembered that the amount of organic matter obtained in the above way by weighing and burning may be equal to several grains in a gallon, and yet be quite innocent; for example, it may be a little peaty matter. One method of trying the quality is given above; another, of a very convenient kind, is by the use of permanganate of potash, or mineral chameleon. It will here be called chameleon, as the former term is very long. It is very highly coloured, and its decomposition is known by the disappearance of the colour.

Chameleon is decomposed by putrid organic matter, and by several unwholesome gases, rapidly or instantaneously. It is decomposed by fresh organic matter, and especially organised matter, less rapidly. The putrid portion may be estimated readily; the latter is more uncertain.

In using this test, it is well to take not less than 5000 grains of the water, or, still better, 1000 grammes, *i.e.*, one litre; but if a small specimen only can be obtained, then as little as 1000 grains may be used; but it is well always to give the figures for 1000 for uniformity, or (by multiplying by 70) to change them into the amount per gallon; one million, however, is still better, and I propose to use

* From vol. iv., 3rd series, of the *Memoirs of the Literary and Philosophical Society of Manchester*. (Communicated, with emendations and alterations, by the author).

it always for air and water. Grains or grammes may be used indifferently, the solution being made to contain simply so much in 1,000,000.

A convenient plan is to use 2 grains of the pure crystallised chameleon to 1000 of water. This, of course, is the same as 2 grammes to a litre of water.

The chameleon is poured conveniently from a Mohr's burette, or, better still, when the water is very pure, from a dropping-tube in which 1 c.c. is 6 to 8 inches long. Add a drop of the chameleon, and wait till the colour disappears; add another, and so on, till the colour remains permanent. The organic matter which decomposes the chameleon in a minute or two must be noted carefully; but generally there is a greater quantity which decomposes very slowly; the result obtained from the latter is, I believe, of less value. By decomposing in a minute or two, it is meant that when a few drops are added, producing a slight colour, this undergoes a change in a minute or two. But generally, considerable permanency is obtained in ten or fifteen minutes; then the slow decomposition begins of quite another quality of organic matter, requiring hours, or even days. This matter must be estimated either by the weighing process described, or by the further action of the chameleon, to be described. The amount decomposed instantly is a true measure of the putridity, it is believed. If there is very much organic matter, it is often very difficult to know when to stop, as the brown masks the red colour. But this must not bring discouragement, as experience will teach exactness; and, if it does not allow exactness, it then will be no great loss in such cases in a sanitary point of view, as in them there is decidedly too much organic matter, and the water may be condemned. From the same point of view, it is of less consequence whether the amount be a minute quantity more or less. It is well to make broad lines of distinction, and to condemn freely when there is rational hope of obtaining a purer water.

The amount of available oxygen in one of the solutions of chameleon described is 0·0005, which may be either grammes or grains, or almost exactly 1 of oxygen in 2000 of the solution. If we wish to know the amount of oxygen used, we simply divide the amount of chameleon by 2000. It is probable that the use of the oxygen column is the only exact method of recording the results; and it is probable that the amount of oxygen required is the only exact measure of the impurity of the substances. We obtain in this number the amount of oxygen which is required for purification.

Whilst looking over this plan in manuscript, I received Dr. Miller's paper, proposing also to use oxygen; he prefers a solution of chameleon containing 3·95 grains, equal to 1 grain of available oxygen to 10,000 of water, or 1 c.c. = 0·001 gramme, or, say, 1 milligramme of oxygen. This is a very convenient method; but it has been thought proper to keep the tables as given for various reasons, chiefly arising from this—that it has not been found so convenient to keep or to titre a very weak solution. In some cases, a very strong solution is required; we can easily dilute it, but we cannot concentrate it readily. After estimating its strength, we dilute it (if we require a weak solution) to any amount we think proper; and as the strength changes, the amount of water to be added will also change. If the amount of oxygen is given as the result of the analysis instead of the amount of chameleon solution, the strength of the latter does not require to be kept uniform. The analyst requires only to know its strength at the time of using it. For very bad water, the strong solution may be used; and, when greater delicacy is wanted, it may be diluted. The weak solution here used is made by adding nine of water to one of the strong solution.

To make the chameleon solution, very pure water must be employed, and very pure crystals, as well as very pure vessels; it is better kept in considerable quantities, such as a quart or two. It must be tried occasionally, say every month, in a cool climate: calculation must be made as allowance for any change which it may undergo. If calculation is not agreeable, a less quantity of solution may be made at a time, and that which is over may be thrown away, a fresh amount being made to the normal strength whenever the original weakens; or a certain amount of the crystals may be weighed and added to the solution; but this has been found less convenient.

The estimation of the value of the chameleon is sometimes made with a solution of chloride of iron, sometimes oxalic acid. For ready reference, a table is made showing the amount of a solution of iron which corresponds to a certain amount of chameleon. The sulphate of ammonia and iron has proved to be very valuable. The writer has not found oxalic acid equally sharp and quick; but eminent chemists use it—Mohr and Miller, for example.

Values of the Strong Solution.

Permanganate of Potash or Chameleon 2 grammes in 1000 c.c.	Oxygen.	Ferrum.	$FeO,SO_3+NH_4O,SO_3+6Aq.$	KO,Mn_2O_7.
c.c.	gr.	gr.	gr.	gr.
1	0·000500	0·0035	0·0247	0·002
2	0·001000	0·0070	0·0494	0·004
3	0·001500	0·0106	0·0742	0·006
4	0·002000	0·0141	0·0989	0·008
5	0·002500	0·0176	0·1237	0·010
6	0·003000	0·0212	0·1484	0·012
7	0·003500	0·0247	0·1732	0·014
8	0·004000	0·0282	0·1979	0·016
9	0·004503	0·0318	0·2227	0·018
10	0·005000	0·03535	0·2474	0·020
100	0·050600	0·3535	2·4747	0·200
1000	0·506300	3·5353	24·7470	2·000

The numbers in the above table run in the following proportions nearly:—

Chameleon Solution.	Oxygen.	Iron.	Sulphate of Iron and Ammonia.	KO,Mn_2O_7 Crystals.
2000	1	7	49	4

It is convenient to use six figures of decimals, as they may also be read as whole numbers, meaning so much in a million.

Values of the Weak Solution.

Permanganate of Potash or Chameleon Solution. 0·2 gramme in 1000 c.c.	Oxygen.	Ferrum.	$FeO,SO_3+NH_4O,SO_3+6Aq.$	KO,Mn_2O_7.
c.c.	gr.	gr.	gr.	gr.
1	0·000050	0·00035	0·00247	0·0002
2	0·000100	0·00070	0·00494	0·0004
3	0·000150	0·00106	0·00742	0·0006
4	0·000200	0·00141	0·00989	0·0008
5	0·000250	0·00176	0·01237	0·0010
6	0·000300	0·00212	0·01484	0·0012
7	0·000350	0·00247	0·01732	0·0014
8	0·000400	0·00282	0·01979	0·0016
9	0·000450	0·00318	0·02227	0·0018
10	0·000500	0·003535	0·02474	0·0020
100	0·005060	0·03535	0·24747	0·0020
1000	0·050630	0·35353	2·47470	0·2000

In the oxygen column, 6 and 3 may be left out.

The first and under might be called the first quality of water; from 0·1 to 0·2, the second; 1 would be the tenth.

When it is considered better to acidify the water before adding the permanganate, this is done by adding 3 drops or water-grain measures of sulphuric acid to 1000 grains; some water will demand more; the object is to attain acidity equal to about 3 drops of sulphuric acid in 1000 grains of distilled water. I find Dr. Miller says 50 grains of diluted sulphuric acid (1 of acid to 3 of water) added to 8 ounces of water. Acid enables the oxygen to act on more matter, and more rapidly. Alkalies prevent the action, although they may prepare some of the matter to be more readily oxidised: when the colour has been diffi-

cult to see, the chameleon may have been used with alkali instead of acid, in which case a green colour is obtained, serving usefully as a corroboration.

As an illustration of the mode of examining water so as to obtain the first and the second conditions, if we may so call them, of organic matter, I will quote here a short paper, read to the Philosophical Society of Glasgow, on the water of the river Clyde. I think I there gave the proper use of the permanganate of potash.* There is a very sharp separation between those substances that decompose the permanganate at once and without acid and those which do so on the addition of acid, and after a short time. So decided is this, that I consider them as indicating two different conditions of organic matter.

"I thought it would be interesting to test the Clyde in this way, and for that purpose obtained specimens at various points from near Bothwell to the sea, afterwards continuing till the vessel came near Liverpool.

"The column to observe is number 1 of annexed table of either series. This gives the amount of oxygen consumed instantly, and corresponds, as I believe, to the amount of decomposed matter which has left in solution putrid gases, whatever these gases may be. We may suppose them to be sulphuretted hydrogen in minute quantities, or compounds of sulphur, or organic substances only, or all mixed. In the part of the Clyde near Glasgow, all these compounds will probably be found; as we go near the Firth, the sulphur will be fully oxidised, and the organic compounds only will be the active agents in taking up the oxygen, as they oxidise more slowly.

"The amount of oxygen is calculated from the amount of permanganate employed. The method is an extension of the original idea given out by the late Forchhammer many years ago; the amount of water used was 100 c.c., or 1544 grains. The permanganate required to give perfectly pure water perceptible colour was in every case subtracted from the number obtained.

"The examination of the Clyde is not perfect, but there is much to be seen that is interesting. Specimens ought to have been taken higher than any town on the river.

"The first was taken about 6¼ miles above the quay at Glasgow. We there find the oxygen required for the water to be 0·000045 per cent by weight, or equal to 3·15 grains per 100 gallons. When we come to the Broomielaw, at Glasgow, we find the amount of oxygen demanded had risen to 0·00022 per cent by weight, or 15·40 grains per 100 gallons.

"We then see it steadily diminishing; and when we arrive at Port Glasgow, 20 miles down, it has become equal to that at 6¼ miles above Glasgow. If we had taken the north side, below Dumbarton, instead of the south, on which the vessels sail, the difference would have been greater.

"Leaving Greenock, and turning the point, we have a rapid change; and when off the west of Gourock Bay, at the distance kept by the Liverpool vessels, the amount of oxygen demanded fell to 1·05. Off Wemyss Bay, the fall is remarkably low; but it is not always so, as it depends on tide and wind. The current seems to run down the centre, whilst the ocean water comes up the coast. The winds and floods may modify this.

"We have to observe a complete change about Gourock or the Cloch, if we keep to the south and east side; but, if we keep to the north, the greatest change is perceptible not far off Helensburgh.

"This wide space of water reduces the amount of oxygen required to 0·00001 per cent by weight, or 0·7 grain per 100 gallons.

"We are now led to ask if the purest state of the water is attained here. We may go further towards the open sea, and find that the amount required falls to 0·000005 per cent by weight, or 0·35 grain per 100 gallons. This is at Arran, where the sea is more extensive, and oxidation, even of the peaty matter from the hills, is nearly completed. We observe this to continue till the entrance of the North Atlantic is past; and, as we come south, to a narrower channel, the amount of oxidisable matter increases, and keeps up steadily till we arrive at Liverpool. No specimen was taken nearer than 17 miles from Liverpool. The point 0·00001 per cent oxygen by weight, or 0·7 grain per 100 gallons, is an important one to examine. We find that at Dunoon, Innellan, and Holy Loch, this amount may be called permanent. We may ask, Why does it not fall lower? and is it true that the sewage of Glasgow affects the Firth until we arrive at Lamlash, and obtain the number 0·000005 per cent oxygen by weight, or 0·35 grain per 100 gallons?

"We observe that the amount of purification is remarkably rapid whenever the Clyde widens, as at Greenock to Gourock; so that, even near Helensburgh, the number has fallen to 0·0000125 per cent oxygen by weight, or 0·875 grain per 100 gallons. This change, from 0·000045 or 3·15 grains per gallon has been effected in the space of about 2 or 3 miles. Is it possible, then, that the slight further change required demands all the wide distance between Gourock and Arran? I think not. The reason we do not find the number for oxygen falling below 0·00001 per cent by weight, or 0·7 grain per 100 gallons, at Holy Loch, Strone, Dunoon, and Cove, may be seen by examining the Lochs. We there find that they themselves send in water with the oxygen number 0·00001 per cent by weight, or 0·7 grain per 100 gallons.

"At this point we must remember that the oxygen may not all be required for putrid matter, and that the streams contain some peaty matter which may also instantly require oxygen. At any rate, we know this, that, for whatever they do require it, it can be for the destruction of no very unwholesome matter in the water, as the highland streams must be considered free from such taints. There is a little of the soil of cattle when the weather is wet, but perhaps none when the weather is so dry that the water must pass through the earth before reaching the bed of the stream.

"We cannot, then, expect the sea-water to demand less oxygen than the streams and lochs that affect it here. In other words, we discover the influence of the land on the drainage from the hills, even when all trace of the influence of Glasgow has gone. This is, I believe, the reason that, according to circumstances, such as currents and weather, we observe the water of the Firth sometimes as pure as the deep sea, and at other times less so. At Wemyss Bay, for example, the table does not show this very well. This will happen at other parts of the coast when the streams enter purer than the usual sea-water there, as, for example, at Dunoon and Innellan, where the water flows from streams equal, when not in flood, to the deep Firth water. We see the influence of the coast, also, as we go on towards Liverpool, and between the Isle of Man and Lancashire.

"I considered that 0·00001 per cent oxygen by weight, or 0·7 grain per 100 gallons, marked the limits of the Glasgow sewage. If the sewage were not all expended, the amount would be greater, because the lochs and their streams do not show a higher number. Whenever the water of the Firth falls down to that of the streams, we are, as I suppose, receiving the air at least as pure as the air above the streams on the hills, and may be contented.

"Some people will perhaps demand more than this number. I have not made examinations far enough towards the ocean to enable me to speak of it; but it seems to me that the numbers 0·00001 per cent by weight, or 0·7 grain per 100 gallons, of the streams, and 0·00005 or 0·35 grain per 100 gallons, mark two very important points. The first characterises air which is certainly most wholesome and agreeable; the second is that ocean air which some persons require, but which to others is

* We never understood the author of this paper to claim having first used permanganate of potash for water. He readily acknowledges being later than Dr. Miller and Dr. Woods, and still later than Mr. Condy, who seems first to have carried out Forchhammer's idea. He simply wishes to show his mode of analysis and the results, leaving the question of merit entirely aside. *Ed.* C. N.

said to be too strong. On the meaning of this expression "too strong," I will not attempt to speak; but it is very much used by a great public, and it must have a wide foundation. It is apparently certain that to some it is important not to have the extremely strong or perhaps purest air.

"These observations seem most curiously to coincide with general observation. The current of the Clyde keeps to the south; and we see that the water changes less rapidly there. At the north the direct current is not much observed, and the influence of the lochs or fiords is seen. The water from them presses against the Clyde current, and aids in keeping it to the south-east. This has influenced the building of the numerous residences on the Argyle side, lining all the coast. The population has not found it needful to make a chemical analysis, but has seen where the purest water was with the unaided eye. A mode of observation, apparently quite as good as chemical analysis, is the examination of the rocks on the coast, the dark and dirty aspects of these in impure water being very striking.

"I am not, however, inclined to look on my work here as useless, although common observation has done its part so well. I believe it to be of great importance to us to be able to apply tests so as to prove the truth of popular belief, which is formed by long and tedious processes. With these little chemical experiments we may do the work in an hour, which the instincts and expensive experience of whole generations were required to perform.

"I believe that in these results we have a method of examining the coasts which will be valuable to us as a sanitary police. It can be applied wherever there are sheets of water.

"I will not say that these numbers represent the relative wholesomeness of places on the land and on the sea; but I think it probable that they may fairly be used as comparisons of places on the sea only. When the land is in question, there are many sources of emanations to be considered.

"To be complete, the examination ought to be continued for several years. Last year was not an average one; there was much rain. (This regarding the Clyde and the sea was read in Dec. 1866.)

"There are floods in the Clyde which bear down so much water that the brown peaty matter is readily seen below Dunoon; but on these occasions there is no fear of putrid matter, as the water carried down is so abundant. At the same time there will be a certain degree of purity less at the sea-entrance, corresponding to the greater degree of purity caused by the flood at Glasgow. By this it is not meant that the water as low as Cloch or Dunoon is affected by more than an infinitesimally small amount of the sewage matter which is washed past Glasgow in floods, whilst at other times the effect has ceased, as before said, at least on the north, below Helensburgh. There is, however, a little muddiness observable for many miles, and this will be found even in places where the oxidation of all the readily transported matter has taken place.

"Even where total oxidation has occurred, a little muddy matter remains. It consists chiefly of earthy bodies, which may float until they obtain a suitable place for deposit.

"It would be interesting to find the time needful to perform this change on the organic matter of Glasgow. We see that the great bulk of the purification is performed in the fresh water. At Dumbarton it must be rare indeed that anything can be known to exist in the water from its smell. When the Clyde passes into the estuary, which may be said to begin at the Rock of Dumbarton, the change is effected by spreading the water over many square miles, and preparing it effectually for those who enter the sea- and Loch-regions below Helensburgh. Below this point it is not a river on which we are, but an arm of the sea, protected on all sides from oceanic waves.

"The water bears the qualities of coast-water in proportion to its excessive length of coast. This quality must exist more or less on all coasts which have fresh springs running into them. In cases where the rivers are large or numerous, the evil of the meeting of fresh and salt water is well known. On the Firth of Clyde no large bodies of fresh water are found after we leave the mouth of the river portion of the Clyde; and, as observed, these streams are remarkably pure, or, if coloured, it is only by peat-water. The absence of great rivers is therefore an advantage of an important kind to this coast.

"I was extremely glad to be able to speak thus favourably of the districts which are so agreeable to me; but I am certainly desirous of speaking still more favourably of some which are too much affected by Glasgow. They may be constantly deteriorating. This is a very serious matter, not merely for owners of property on the Firth, but for all the inhabitants of Glasgow, who are favoured more than those of any other large city in the kingdom by a ready access to this wonderful sanatorium.

In making these remarks, I take for granted that the air above the water will be pure in inverse proportion to the amount of volatile oxidisable matter.

"We must not, however, forget that, if the river is rendered impure, the town is proportionately purified. And we must also remember that the work done in the water is enormous. If the refuse matter were allowed to evaporate into the air, and so collect its oxygen, the act of purification would go on in the air we breathe; but now the water draws in oxygen, and, as soon as it is consumed, it draws in more. Even the air over the river is, at a distance of a few miles down, purer than the air of many towns; and when the spaces widen, the case is stronger still.

"I have sometimes inquired if we obtained in fish an equivalent of the manure sent out, and if it is not easier to gather the crop in boats than to put the manure laboriously on land. I find, however, that the loss by putrefaction, oxidation, and evaporation is so rapid that there was no hope of it being used profitably. In one current examined, a very deep one, and much stronger in sewer matter than the Clyde ever is, the whole nitrogen had disappeared in three days, the greater part in much less.

"Whilst the chief object of my paper is to show a new mode of examining climate as well as streams, I am glad to be able to say that Glasgow has failed to destroy the purity of the Firth beyond the points indicated, and that we may still rejoice in our summer dwellings. It is, however, not to be forgotten that the effects are found too far away, and that twenty-two miles of mischief is more than abundance. It is to be hoped that the cautious policy of the City in waiting for the best method to be adopted for using its refuse will enable it to carry out that future work, whatever it may be, with the greatest success.

"I have referred only to the 1st column: it indicates the amount of permanganate decomposed instantly; this represents the gases of decomposition, such as most readily pass into the atmosphere.

"It will not be supposed that this is the only offensive matter.

"The 2nd column represents the amount when acid is used to assist the oxidation. I suppose this to represent the amount easily decomposed.

"The 3rd column of the original paper, left out here, represents the amount of oxygen used by the organic matter in twenty-four hours. I do not at present see its use. I do not think this at all a fair mode of representing the impurity of water, unless we are sure that the quality does not change. We see this by the numbers above, and at Glasgow Bridge. The purer water has, by this mode of representing it, the appearance of being equal to the worst. The only column that gives the continuous increase and decrease exactly as the senses find the case to be is the column No. 1.

Time.	Oxygen per 100 gallons required to oxidise		Oxygen by weight required to oxidise 1,000,000	
	I.	II.	I.	II.
	The decomposed organic matter.	The easily decomposable organic matter.	The decomposed organic matter.	The easily decomposable organic matter.
Aug. 15, '66.				
6½ miles above Glasgow 3.30 p.m.	3'15	11'55	45'0	165'0
5½ miles above Glasgow 3.15 ,,	4'55	9'45	65'0	135'0
5 miles above Glasgow, Cambuslang .. .. 3 ,,	5'95	11'20	85'0	160'0
Broomielaw .. .. .. 1.30 ,,	15'40	22'05	220'0	315'0
Mouth of Kelvin .. .. 1.20 ,,	11'55	18'20	165'0	260'0
100 yds. below Renfrew 1 ,,	10'85	25'55	155'0	365'0
100 yds. above Bowling 12.45 ,,	4'55	8'05	65'0	115'0
At Dumbarton .. .. 12.30 ,,	4'55	6'65	65'0	95'0
Between Greenock and Port Glasgow .. .. 12.10 a.m.	3'15	4.20	45'0	60'0
July 25, '66.				
Gourock .. .. 12.55 p.m.	1'05	1'75	15'0	25'0
Cloch .. .. 12.45 ,,	1'05	1'57	15'0	22'5
Inverkip .. .. 12.30 ,,	0'70	1'40	10'0	20'0
Wemyss Bay.. .. .. 12.15 ,,	0'35	0'87	5'0	125'0
Opp. Toward.. .. .. 12 noon.	0'70	1'05	10'0	15'0
Between Toward and Cumbrae .. .. .. 11.30 a.m.	0'70	1'05	10.0	15'0
Opp. Cumbrae Lighth 11 ,,	0'70	0'87	10'0	12'5
Opp. Lamlash .. .. 10.15 ,,	0'35	0'70	5'0	10'0
July 25, '66.				
188. .. .. 10 a.m.	0'35	0'87	5'0	12'5
176. Ailsa Craig .. .. 9 ,,	0'35	0'73	5'0	10'0
160. From Liverpool .. 8 ,,	0'35	0'87	7'5	12'5
131. ,, ,, .. 6 ,,	0'52	0'87	7'5	12'5
103. ,, ,, .. 4 ,,	0'52	0'87	10'0	12'5
74. N. of Isle of Man 2 ,,	0'70	1'05	12'5	15'0
July 24, '66.				
46. From Liverpool .. 12 night.	0'87	1'22	12'5	17'5
32. ,, ,, .. 11 p.m.	0'87	1'40	12'5	20'0
17. ,, ,, .. 10 ,,	1'05	1'75	15'0	25'0
Aug. 13, '66.				
Off Greenock.. .. .. 5.10 p.m.	1'40	1'57	20'0	22'5
Aug. 15, '66.				
Off Helensburgh .. .. 6.35 p.m.	0'875	1'22	12'5	17'5
Aug. 13, '66.				
Off Gourock .. .. .. 5 p.m.	1'22	1'57	17'5	22'5
Aug. 13, '66.				
Between Kirn and Gourock .. .. 6 p.m.	1'22	1'40	17'5	20'0
July 30, '66.				
Arrowchar (Loch Long) 1.30 p.m.	0'70	1'05	10'0	15'0
Aug. 15, '66.				
Off Mouth of Loch Long 6.55 p.m.	0'875	1'40	12'5	20'0
Aug. 17, '66.				
Head of Loch Goil .. 1.5 p.m.	0'875	1'05	12'5	15'0
Entrance of Loch Goil 4.30 ,,	1'05	1'22	15'0	17'5
Aug. 1, '66.				
Head of Holy Loch .. 2.45 p.m.	0'70	1'57	10'0	22'5
Middle of Holy Loch.. 2.30 ,,	0'52	1'05	7'5	15'0
July 31, '66.				
Dunoon (several 100 yds. from shore .. .. .. 1 p.m.	0'70	1'22	10'0	17'5
Dunoon (about 800 yds. from shore).. .. .. 1.15 ,,	0'70	1'22	10'0	17'5
Aug. 16, '66.				
Off Dunoon .. .. .. 1 p.m.	0'70	0'875	10'0	12'5
Aug. 20, '66.				
Stream at West Bay, Dunoon .. .. .. 1 p.m.	0'52	0'70	7'5	10'0
Stream between Innellan and Dunoon .. 12 noon.	0'35	0'52	5'0	7'5
Aug. 16, '66.				
Between Innellan and Dunoon .. .. .. 1.8 p.m.	0'875	1'05	12'5	15'0
Off Innellan .. .. .. 1.15 ,,	0'70	0'875	10'0	12'5
Aug. 9, '66.				
Off Wemyss Bay (high tide) .. .. 12 noon.	1'05	1'22	15'0	17'5
Off Wemyss Bay (low tide) .. .. 4'30 p.m.	'875	01'22	12'5	17'5

"It is not, however, meant that the gases of decomposition are the only evils to be apprehended from impure water; but, so far as I know, they are those that affect the air principally (from this source). The most dangerous bodies are probably in the water itself, and it is possible that they may not be affected by the process of column 1.

"I am not inclined to draw any important conclusion from the total organic matter without inquiring into its character. At present, I believe, we are quite safe in attending to the conclusions here given in column 1, with such precautions as I have elsewhere indicated—when, for example, nitrites, sulphites, &c., are present. By and by we shall learn the true mode of dealing with the other columns."

(To be continued.)

NOTICES OF BOOKS.

Sound: A Course of Eight Lectures delivered at the Royal Institution of Great Britain. By John Tyndall, F.R.S. Second Edition. London: Longmans, Green, and Co., 1869.

Dr. Tyndall has proposed to himself to publish a series of works on Natural Philosophy, suited not only to the requirements of the students, but, as far as is practicable, to the popular ear. They are to have as their bases, the lectures which he is in the habit of giving, year by year, at the Royal Institution, and already two such handbooks have appeared—the well-known treatise "On Heat Considered as a Mode of Motion," and the treatise "On Sound," the second edition of which we have before us. The value of these works is too well known to the scientific to need any mention here. They form the most complete separate works on the several subjects of which they treat to be found in this language, and Dr. Tyndall is careful to introduce the most recent researches of continental philosophers, many of which are not readily accessible to the English public.

In comparing our scientific works with those of France and Germany, there are, however, several most notable differences; differences which rest with the publisher rather than the author, and until these be overcome we cannot have any great diffusion of standard scientific works in this country. We allude chiefly to the great expense of our works on science, and the above are no exception to the rule. Let any of our readers look at the volumes of the admirable *Bibliothèque des Merveilles* at 2 francs the volume, and ask himself what would be their price in this country—certainly seven shillings and sixpence. They are by eminent men, are well printed, and well illustrated, and such a series would be a great boon to this country. As to woodcuts, they, for the most part, excel those of our best works on science, into which we rarely introduce copper or steel-plates, and coloured engravings less rarely still.

The second edition of Tyndall "On Sound" differs but slightly from the first; the main difference is the addition of an appendix of 9 pages, containing an account of the recent researches of M. Regnault on the propagation of sound, written by himself. Many of our readers have heard Dr. Tyndall's lectures on sound, and will remember how well they were illustrated, specially as regards the production of Lissajous' figures, drawings of many of which are given.

The first lecture treats of the production and propagation of sonorous waves through various media. The second distinguishes between noise and music, musical pitch is defined, and a good account of the admirable "double syren" of Helmholtz (from his "*Die Lehre von den Tonempfindungen*,") is given. In the third lecture is discussed the vibration of strings, the general nature of progressive and stationary waves, and the optical examination of the vibrations of a piano wire. Lecture 4.—The vibrations of rods, square plates, discs, and bells. Lecture 5.—The vibrations of columns of air in organ pipes, the human voice, and reed-pipes. Lecture 6.—Sounding flames which have of late engaged so much attention. Lecture 7.—The interference and coincidence of sonorous waves, and the theory of "beats." Lecture 8.—The conditions of musical consonance, the harmony of musical sounds, and the optical examination of musical intervals.

The work is well illustrated for an English scientific book, and the style is agreeable, yet the book is more for the student than for the general reader; nine out of ten well-educated persons unacquainted with science could not comprehend many of the subjects discussed without reference to other works bearing on the subject. As a handbook for the student of science it is a valuable contribution to our scientific literature.

Traité Eléméntaire de Physique. Par A. PRIVAT DESCHANEL, Ancien Professeur de Physique au Lycée Louis-le-Grand. Paris: Hachette et Cie. 1869.

DURING the last few years, there has issued from the French press (and notably from the press of Messrs. Hachette) a series of beautifully-illustrated works, having for their object the popularisation of science. We need not do more than refer to "Le Ciel," and "Les Phénomènes de la Physique" of M. Guillemin, with their beautifully-coloured plates, their copper-plates, and their innumerable woodcuts. The recently-translated "Vie Souterraine" of M. Simonin is another example. In fact, the world has shown its appreciation of these works by the rapidity with which translations have been made into numerous languages. We saw the other day an "edition de luxe" of Guillemin's "Le Ciel" in Greek; and we should suppose that, by this time, it is to be found in Hindoostanee, perhaps in Chinese. There is no denying that we have no books among our native scientific literature which can compare with these: somehow our drawings of apparatus are heavy and cold, there is nothing artistic about them, and they are too often repellent to the eye, rather than attractive.

The book before us, although not belonging to the class of "Le Ciel," boasts three coloured plates, and 719 woodcuts in its thousand and eight pages. It is rather a student's manual than a popular work on physics. The subject matter is arranged in the following order:—Mechanics; Hydrostatics; Pneumatics; Hydraulics; Heat; Electricity; Acoustics; Optics. "Le traité," says M. Deschanel, "que je publie aujourd'hui est destiné à faciliter le travail des jeunes gens qui veulent obtenir ces grades" (universitaires), and, coming as it does from a man who, for nearly twenty years, was Professor of Physics in the Lycée Louis-le-Grand, it is a valuable contribution to French educational works.

Although by no means overloaded with mathematics, we are glad to observe the introduction of mathematical formulæ, wherever it is possible, without adding a great complexity to the matter discussed.

In the "Pneumatics," we notice an account of M. Kravogl's mercury air-pump, also of that of Geissler, but we seek in vain for mention of the admirable Sprengel pump.

The chapters on Heat are good, and are clearly written, but we think an insufficient mention has been made of Tyndall's experiments on the absorption and radiation of heat by gases, while the space devoted to the mechanical theory of heat is undeniably too short.

A good account, accompanied by a capital drawing, of the "machine à gaz" of MM. Otto and Lungen will be found on p. 306, and of the electrical machine of M. Holtz on p. 357. The subject of static electricity has been discussed with perhaps more diffuseness than any other subject. In dynamic electricity, we notice a very clear exposition of the actions of solenoids.

A chapter is devoted to the "Effets calorifiques produits par les courants," in which will be found a charmingly artistic drawing of the magnified "image des charbons" of the electric lamp; and, while we are on the subject of the woodcuts, let us mention No. 576 ("Propagation du son dans un milieu indefini") as singularly felicitous and elegant.

Of the book as a whole, we may say that we cordially recommend it to the student of science; he will find it clear and concise, abounding in good woodcuts, and remarkably moderate in price.

CORRESPONDENCE.

EXPLOSION OF NITROGLYCERINE.

To the Editor of the Chemical News.

SIR,—The frightful explosion of three-quarters of a ton of nitroglycerine in Wales, last week, and the deplorable loss of life and injuries attending it, may probably lead to some consideration on the part of the authorities as to whether an explosive agent apparently so unsafe should be allowed to be imported, or even used, in this country, notwithstanding that it appears to be established, at least to the judgment of many competent authorities, that for blasting a certain class of rocks there is no other agent at once so cheap in proportion to power and so effectual as nitroglycerine. The explosion referred to does not appear to have been the result of any carelessness; the "oil" was packed in metal canisters, which were surrounded by sawdust, and no one who has experimented with nitroglycerine can well attribute the explosion to any concussion that could have been caused by the jolting of the waggon in which it was conveyed, over, even, a somewhat rough road. Must, then, this explosion be classed with that which took place in Australia when the oil was at rest in a cellar? It would seem so. But if so, no confidence can be felt in employing an agent which may go off at any time; and the risk to life and property incurred in using it, will overbalance any possible advantage to be derived from its economy and efficiency.

Yet it is stated that nitroglycerine is *safer* than gunpowder. It is certainly less liable to be exploded by fire, and to disrupt the slender link which retains its elements, subject to chemical force, and set its mechanical force at liberty, by concussion, needs that concussion be sudden and forcible. I believe that a bottle full of blasting oil may be dashed to the ground without much danger, yet a drop of it upon a stone may be exploded by a blow from a hammer. Now what can be the possible cause of such unexpected explosions as have taken place? I can see only two possible reasons—First, that the oil undergoes decomposition or chemical change under certain at present unknown conditions, of time, temperature, shaking, &c., which predispose it to undergo a complete and sudden decomposition from causes ordinarily inadequate; secondly, that the cases and bottles in which it is contained, being air-tight, are liable, from a very trifling escape of gas from the liquid, to arrive at a state of tension from which the passage to a sudden break is easy. But would the mere bursting open of a bottle or tin case produce concussion sufficient to determine an explosion of the oil, unless we suppose the latter to be altered in quality? I think it would. I have known a stout glass bottle, used in an ethyl experiment, to be shattered by slowly gathered internal pressure into *dust*, with a report like the firing of a pistol. In a close vessel, full, or very nearly full of the oil, not much gas relatively to the quantity of liquid need be evolved in order to induce such a degree of pressure as might cause explosive rupture of the vessel. If one vessel burst, the concussion would certainly explode also any that might be near.

If the true cause of these seemingly anomalous explosions is indicated above, the remedy is both simple and inexpensive. Let every vessel containing the oil have fitted to it a tube, with a capillary bore, such as a piece of thermometer tubing, one end of the tube entering the oil, the other exposed outside.

If the tube were enlarged below to make room for any expansion of the liquid by elevation of temperature, none could be forced out by that alone, and none could be spilt through the capillary orifice of the tube by inverting the vessel. With a little management in the arrangements, any overflow might be made certainly indicative of the formation of permanent gases, which would be a warning signal. This method might also be applied experimentally

to determine the probability or otherwise of the suggestion I have made as to the cause that may have led to these fearful explosions.

Certainly, the time is come when science should, in the cause of the public safety, investigate the "why" and the means of prevention of such horrors as that of the late catastrophe.—I am, &c.,

E. S.

Ramsay, Isle of Man,
July 7, 1869.

THE CHEMICAL SECTION OF THE BRITISH ASSOCIATION:

THE OFFICIAL REPORT.

To the Editor of the Chemical News.

SIR,—On comparing the official report of my paper entitled "Researches on the Ethers," with my paper as it appeared in the CHEMICAL NEWS some time ago, I was astonished to find striking differences between them.

In justice to you as well as to myself, I beg to state that the version which you have published is the authentic version, and that in the official one the alterations have been made without my knowledge. Possibly I may bring this matter before the Exeter meeting of the Association.—I am, &c.,

J. ALFRED WANKLYN.

London Institution.

MISCELLANEOUS.

Ashberrium, a New Alloy, consists of 80 parts of tin, 14 of antimony, 2 of copper, 2 of nickel, 1 of aluminium, and 1 of zinc.—*Polyt. Centr.*

New Alloy for Stereotyping.—M. Ed. Hofer-Grosjean recommends the use of an alloy, consisting of lead 50 parts, tin 36, cadmium 225; this alloy is readily fusible, and is harder than the alloy containing bismuth now applied for stereotyping purposes.—*Polyt. Centr.*

Mineral Lemonade.—When equal parts by weight of strong pure sulphuric acid and strong pure alcohol (85 to 90 per cent) are carefully mixed (the acid being poured into the alcohol and thoroughly mixed therewith), a liquid is obtained which has long been known and used by medical men under the older name of *Elixir acidum halleri*, more recently named *Mixtura sulphurica acida*. This fluid, which, if well prepared, contains essentially sulphovinic acid, is an excellent summer beverage when mixed with water in the proportion of one small teaspoonful to a tumbler of cold water, and sweetened with sugar, or, preferably, with some fruit syrup. Above the lemonades made with vegetable acids, this acid mixture has the advantage of not increasing the perspiration, as citric and other vegetable acids do, while, it is better borne by the stomach, and has a tonic action upon the vascular system. It is, indeed, a very pleasant drink, often given, at the *cafés* of Paris, Berlin, Vienna, and other places, along with some *syrop de groiselles* or *framboises*, and rather exorbitantly charged for. The proportions by bulk are—one of strong sulphuric acid and three of alcohol.—*Hamm's Agronomische Zeitung.*

Cellulose in Old Wood.—M. Payen has taken the trouble to analyse a piece of old woodwork, once belonging to the well-known Chaillot pumps, in order to ascertain what state the cellulose was in, after fully a century's exposure to wind and weather; he therefore treated the wood—first, for eight consecutive days, with a weak solution of caustic potassa (1 part in 10 of water), at a temperature of between 20° and 75° C.; secondly, he treated the residue with nitric acid, sp. gr. 1·2, without applying heat, and also for eight days; next with nitric acid, sp. gr. 1·05, taking care to wash out carefully all substances which, by each of these operations, could have become soluble, previous to proceeding with another operation; M. Payen obtained pure cellulose, as might have been expected, and was evidently also expected by Field-Marshal Vaillant, who happened to be present when the *savant* deposited, at a meeting of the Agricultural Society, a piece of pure cellulose obtained from the wood of the old pump, since the Marshal asked Payen, jocosely, whether he had not some old wood from the ruins of Carthage to operate upon; and M. Robinet, improving upon the occasion, offered to send Payen a piece of the wood of Noah's Ark, to continue his researches.

Fusibility and Volatility of Metals.—While engaged with experiments on the intrinsic composition and constitution of various pieces of silver money, made at the Royal Netherlands Mint, at Utrecht, Dr. A. von Riemsdyk carried on some experiments on the fusibility and volatility of metals, from the published record of which we abstract the following:—The metals tin, bismuth, cadmium, lead, and zinc, as chemically pure as they can be obtained, were molten, in order to prevent their oxidation, in a feeble, but constant, current of pure and dry hydrogen gas. The author found that—(1) the melting of these metals does not, either mechanically or by evaporation, give rise to any loss at all; (2) that *tin*, *lead*, and *bismuth*, when kept in a liquid state, are not volatile at temperatures greatly in excess of their melting points, and that, at a bright red heat, quantities of 2·3433 grms. of *bismuth*, and 4·5183 grms. of *lead*, did not lose, by being kept at that temperature for one hour, more than 1 and 0·5 m.m., respectively, by evaporation, while *tin* did not exhibit any volatility at all; (3) that *cadmium* and *zinc*, though completely fixed, non-volatile, at their melting point, begin perceptibly to volatilise at a few degrees above that point; (4) that there does not exist any relation at all between the fusibility and volatility of these metals, which may be arranged in the following manner, beginning from the most fusible and most readily volatile:—

Fusibility.		*Volatility.*
Tin	228·5° C.	Cadmium.
Bismuth	268·3° „	Zinc.
Cadmium.. ..	320·0° „	Bismuth.
Lead	326·0° „	Lead.
Zinc	420·0° „	Tin.

(5) that the so-called Rose's fusible metal, an alloy of tin, lead, and bismuth, the melting point of which is about 97·5°, and certainly not higher, is not perceptibly volatile when heated to a bright red heat in a current of pure hydrogen gas. Silver, unalloyed, melts at 1040° C., pure gold at 1240° C., while the author found that chemically-pure copper requires a temperature of 1330° C. to become liquid. Neither pure silver, nor pure copper, nor also the alloy of silver and copper containing 945-1000ths of the former metal (this alloy is the standard alloy of the Netherlands silver coins), loses anything at all by volatilisation when kept for a considerable time at temperatures higher than the melting points of both these metals, and in a feeble current of pure hydrogen to prevent their oxidation. The author has made some of these experiments on a very large scale, having at his disposal large quantities—several hundred kilos.—of these metals in pure and alloyed state; he also describes an ingenious pyrometer devised and invented by him, but space forbids us to enter into further details.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, vol. lxix., No. 1, July 5, 1869.

A very considerable portion of this number is filled with a lengthy discussion on some ancient letters and papers of historical interest. Incidentally with this subject, M. Balard stated that, having made use of M. Carré's plan to immerse written papers in dilute hydrochloric acid (one part, by bulk, of acid, to ten parts of pure water), he found very old writing to resist, even for fully twenty-four hours, the action of this acid, and that, although the figures become rather yellowish, they were perfectly and distinctly legible; yet, though this holds good for the documents operated upon, which were written between the years 1577 and 1770, it does not for documents tested in the same manner and written between the year 1793 and 1867. The observation was made that some ancient writing turned red in the acid; and, since this indicated the use of logwood in the ink, it was doubted whether this material had ever been applied at so remote a date as even the end of last century for ink making. M. Balard stated that he had found, in books printed and published more than 100 years ago, prescriptions to make black writing ink with logwood. M. Chevreul asked M. Balard whether he had tested the inks for oxide of manganese, since some prescriptions for the manufacture of black writing ink advise the addition of a salt of the protoxide of this metal, in order thereby to have a means of detecting any attempt to destroy the writing by means of chlorine. M. Chevreul pointed out the great difficulties in testing, by such methods, any writing, owing to the composition of the ink, the kind of paper, wherein it written, its sizing, and the very varying conditions wherein written documents may have been kept.

Researches on the Galvanic Battery, and the Origin of the Heat which is Produced in the Elements and is not Transmissible to the Conducting Wires.—M. Favre.—This is another portion of a lengthy memoir on this subject, and is full of allusions of

tabulated results, which cannot be left out without impairing the value of the research; we therefore only quote the title.

Poisonous Properties of Coralline, as used for Dyeing Purposes.—M. Tardieu.—This author, although not wishing directly to contradict M. Laudrin, insists upon the fact that silk stockings, dyed with coralline, and absolutely free from any such substances as arsenic, mercury, or lead, cause, to those who wear these on their feet, in many instances, grave inconvenience, certainly not due to the silk, and thus, inferentially, due to the dye.

Heat of Transformation of some Isomeric Bodies.—MM. Troost and Hautefeuille.—This memoir, a physico-chemical essay, treats of—1st, the heat of transformation of cyanic acid into cyamelide; 2nd, the heat of transformation of cyamelide into cyanuric acid; 3rd, on the relation which exists between the heat given off by the combustion of a substance and its specific gravity (under this head, sulphur and arsenious acid are treated).

Relations which Exist between Amido Acids, derived from Benzoic Acid, and the Alkaloids derived from Toluen.—M. Rosenstiehl.—The author says, there exist three acids, the composition of which is expressed by the formula $C_7H_5(NH_2)O_2$; they are—the *amido-benzoic*, *amido-dracylic*, and *anthranilic acids*; we are acquainted, moreover, with only two homologous alkaloids—to wit, *toluidine* and *pseudo-toluidine*. In order to elucidate the question, What relation there exists between these acids and the alkaloids, the author has acted upon these acids with hydriodic acid at a temperature of from 180° to 200°. The amido-benzoic acid yields pure toluidine, without any secondary product; amidodracylic acid yields pseudo-toluidine, but a secondary reaction takes place simultaneously, whereby carbonic acid, aniline, and hydride of methyl are formed; anthranilic acid behaves as amido-dracylic acid.

Solubility of Sulphur in Coal-Tar Oils.—M. Pelouze.—The author has operated with light benzines, sp. gr. 0·870 to 0·880, the former boiling between 80° and 100°, the latter between 85° and 120°; heavier benzines, sp. gr. 0·882 to 0·885, the former boiling at from 120° to 200°, the latter at from 150° to 200°; heavy oils, sp. gr. 1·010 to 1·020, the former boiling at from 210° to 300°, the latter at from 220° to 300°. The temperatures at which the solvent action upon sulphur was tried with these divers liquids, varied from 15° to 130°. The light benzines dissolve in the range of temperature up to their boiling point, from 2·5 per cent to 27 per cent of sulphur; the heavy benzines dissolve, for the same range of temperature, from 2·5 per cent to 38·7 per cent of sulphur; while the heavy oils dissolve in a range of temperature, from 15° to 110°, from 6 to 115 per cent of sulphur, and above 110° to 130°, indefinite quantities of that metalloid. At temperatures ranging from 200° to 300°, sulphur decomposes the heavy oils, sulphuretted hydrogen being set free.

Les Mondes, June 17, 1869.

We notice from this paper, in the first place, the few, but interesting words written by the Rev. Father Secchi, S.J., to M. F. Mazeo, at Turin—

On Electricity.—"I believe that the true theory of electricity will result from the principle that electricity is not a motion (*mouvement*), but a change of the quantitative and dynamic equilibrium of the ether which constitutes the atoms of the substances, and that the propagation of such a change is brought about by the moving of the ether from one atom to another; this motion shakes, disturbs the ether of the atoms, and thus produces heat."

Balances of Great Precision.—It appears that the celebrated physical instrument makers, Collot, Frères, Paris, have greatly improved the mode of making balances, by devising what is called a balance on two columns. Without reproducing the woodcut contained in the above-named periodical, it is not easy to describe this instrument so as to be clearly understood by our readers; the system is an entirely new one, and by its application only is it possible to place the point of support on the axis of the balance, and thereby to shorten the length of the arms which bear the weight. Among the particulars mentioned of balances made according to this new system, we quote a balance made to bear, in each pan, 35 kilos., and sensitive with that load for 5 milligrms., and possessing, at the same time, perfect stability. Several balances of this kind have been made for the Russian Government; and the University of Upsala, Sweden, has two balances, each to carry 1 kilo. in each pan, and sensitive for 1½ milligrm. The laboratory of the School of Mines, Paris, has received, from MM. Collot, a balance of precision which, the author says, excels anything hitherto made. Balances with aluminium beams have also been introduced by these makers.

Among the acknowledgements of books received, we notice brief reviews of two small pamphlets, written and published in Italian, by the Rev. Father Secchi, S.J. The first of these books is entitled "*The Prismatic Spectra of the Heavenly Bodies.*" Contents—1st, the prismatic spectra of the fixed stars; 2nd, the catalogue of the stars of which the luminous spectrum has been determined; 3rd, description of the instruments applied in this investigation. The work is illustrated with beautifully-executed engravings, and is, according to the opinion of the reviewer in *Les Mondes*, an almost herculean labour, executed with a care and precision which might, at first sight, appear to be beyond the powers of one man. The other work is on "*The Nebula of Orion*," and is rather an astronomical essay.

Researches on the Propagation of Sulphuretted Hydrogen Gas through other Gases.—Dr. Hillebrandson.—The author of this memoir, originally published in Swedish, has made a series of experiments with sulphuretted hydrogen gas, because it is very readily detected, and its presence shown among other gases; these experiments fully confirm what is already well known on this subject.

June 24, 1869.

This number contains more information on the subject of the—

Oxyhydrogen Illumination.—L'Abbé Moigno.—This paper is written with the express view of meeting the objections made in public prints against this mode of procuring artificial light, and answers each objection completely. The first objection, made and refuted, concerns the alleged difficulty which oxygen is supposed to have, of passing readily through pipes, and travelling therein with ease, on account of its high specific gravity; the author states that experience has proved that, under the same, and, in all respects, identical conditions, oxygen gas travels more rapidly than hydrogen. Another point is an objection concerning the comparative rare occurrence of peroxide of manganese, and the difficulty of obtaining it; to this the reply is, there is plenty of manganese, of excellent quality, readily accessible, and more than fifty times as much as any greatly-increased demand will ever absorb; moreover, the oxygen is made from permanganate of soda, which, it appears, is revived again after having yielded its oxygen. One ton of this permanganate yields in twenty-four hours 100 cubic metres of oxygen; and, from reliable data obtained, 300 tons of the salt will suffice to produce yearly about 10,000,000 cubic metres of oxygen gas (a cubic metre is equal to 35·316 cubic feet). These 300 tons of permanganate are composed of 150 tons of soda, and 150 tons of peroxide of manganese, an insignificantly small quantity, compared with the 60,000 tons which are consumed of this material annually. As to the too slow production of oxygen, the author says, at the oxygen gas-work, when in regular course of working, they have obtained, from each retort, 38 cubic metres of pure gas per day; as to the cost, he states that the gas-work intended to be established will cost, everything included (retorts, &c., gas-holders to hold 24,000 cubic metres of gas for twenty-four hours' supply, 32 kilometres' length of mains), 3,700,000 francs; as to the objection concerning the zirconia, or magnesia cones, these last for several days, and only cost one centime; at the same time, the glass chimneys and globes are dispensed with. As to the expense of this gas, it appears, from the statements of the author, that, taking into consideration the great quantity of light obtained, it is decidedly less expensive. The manufacture of hydrogen, by means of the patented process, from hydrate of lime, is, according to the author, very simple, and the pure hydrogen thus obtained costs less than two centimes per cubic metre, leaving even out of the question the sale of the by-products, which would not be trifling. Lastly, the author tells us that MM. J. Dumas (Senateur, &c.), Jamin, Balard, and H. Sainte-Claire Deville, all Members of the Institut; M. Debray, of the French Imperial Mint; and M. Alphand, Director of Public Roads and Promenades, have been appointed a committee, by M. Haussmann, Préfet du Département de la Seine, to inquire into, and minutely report upon, this subject in all its aspects and details.

July 1, 1869.

We learn from this number that M. Wurtz, of Paris, has been on an inspection journey to Germany, by order of the Minister of Public Instruction, to report upon the chemical laboratories of Germany, and to give his opinion as to the progress of chemistry made in that country. The lengthy report of the eminent Doyen de la Faculté de Médicine of Paris may be summed up in these few words—That the material aid given to chemistry in Germany, has developed that science there to a degree which it lacks in France, as well as in most other countries. It is not for want of zeal and industry, says the eminent *savant*, but for want of the material aid—good laboratories, plentifully supplied with all requisites—that we are behind, as compared with Germany.

Cyanide of Potassium in Blast Furnaces.—M. H. Pajot has made a series of experiments, on the large scale, at the blast furnaces of Randonnay, Département de l'Orne, and found that the fact announced now many years ago, by Messrs. Lyon Playfair and Bunsen, of the presence of cyanide of potassium in blast furnaces, is a reality, and that the salt is formed there in such large quantities that it might easily become a useful and plentiful by-product of ironworks.

Extension of Sulphuric Acid Manufacture.—M. Perret.—The enormous pyrites deposits of Chessy and St. Bel, France, are advantageously applied, by the owner of that mineral deposit, to manufacture, at five different sulphuric acid works, a quantity of no less than 100 tons of concentrated acid daily, exclusive of the simultaneous manufacture of a great many other chemicals, in the preparation of which sulphuric acid is used. The pyrites alluded to contains a sufficient amount of copper to make the extraction of that metal from the burnt pyrites a paying business. This mineral is largely exported from France into those places where it can be taken to at a remunerative price; the locality where the mineral is found is too far away from the sea or any readily navigable river thither to admit of its exportation being extended beyond the limits of localities on and near the Franco-Swiss and Italian frontiers.

The Journal of the Franklin Institute, May, 1869.

Among the Editorial Items and Novelties we meet with the following original communications:—

Invisible Light.—Prof. O. A. Rood.—Many years since, the author says, a photograph was made, at Berlin, of the well-known bronze statue of the Amazon; and it was observed that, in the negative, a

black streak occurred at the tip of the lance (held by the figure in an almost vertical position) while two other analogous marks appeared in other locations. This picture was sent to Prof. Dove (Berlin), whose investigations in connection with light are widely known, and he came to the conclusion that these markings might be due to electrical discharges going on from prominent points of the figure at the time the picture was taken, and which, though invisible to an observer, would, nevertheless, by reason of the high actinic power of electric light, produce an impression on the photographic plate. This conjecture has been fully confirmed by the author, who, in a series of ingenious experiments, proved that electric discharges, entirely invisible to the observer in the presence of daylight, might, nevertheless, produce images of themselves in a picture of the adjacent objects taken at the same time, the photographic plate being relatively more sensitive to these impressions than the human eye. The author describes at length his mode of experimenting; but, without a reproduction of the woodcuts illustrating this paper, it is not possible to enter into more details on this subject.

New Arrangement of the Holtz Machine.—Prof. Smith.—In the ordinary mode of excitation of the Holtz machine, the knobs of the dischargers are placed in contact, and afterwards separated; the excitation cannot be produced without contact. It follows, that, when the balls are separated beyond the striking distance, all action will suddenly cease, and, to renew it, the balls must again be brought together; and frequently, in addition to this, a new excitation of the sectors will be required. A large class of electrical experiments require, virtually, this separation of the balls beyond the striking distance—*e.g.*, the "electrical flyers," the "head of hair," and the insulating stool. The author fully explains his arrangement, so as to keep up an unlimited excitation, whatever be the number of points applied to the prime conductor, or whatever may be the distance of the balls of the dischargers; and, in order to excite the machine, it is not necessary that the balls should be in contact. We cannot, without woodcuts, give more details from this paper.

The greater part of the remaining papers of this number treat on matters of engineering, or are reproductions from papers found in European periodicals, among which the Chemical News occupies a prominent place.

Moniteur Scientifique, No. 300, June 15, 1869.

The greater part of this periodical is occupied with translations of papers taken from English and German periodicals already noticed by us. Among the original papers relating to natural sciences, excluding physiology, medicine, and natural history, we meet with a paper—

On the Rotatory Equivalent of Cane Sugar and Rock Crystal in their bearing upon Optical Saccharimetry.—M. Dubrunfaut.—The author states that the figure, 16·471 grms., which in the year 1850 was adopted as the correct unit for optico-saccharimetrical experiments, is wrong, and has been afterwards altered to 16·350 grms.; he next adduces, as proof of the necessity of a revision, also, of that last figure, some experiments of his, recently made with samples of sugar kept as standards at the French Ministry of Commerce. The author further alludes to the impurities of refined sugar as the cause of these errors, and finally states that, when a really well-made optical saccharimeter is used, and pure sugar, the figure 15·976 grms. represents truly the absolute rotatory equivalent of rock crystal as well as of pure cane sugar. The author quotes the results of an analysis of refined sugar, purified by him, by means of pure absolute alcohol, as follows, in 100 parts:—Ash, 0·00039; water, 0·00030; glucose, 0·00018; and traces of lactic acid. It appears, however, that M. Dubrunfaut is entirely unacquainted with the extensive series of experiments made on this subject in the Netherlands by Profs. G. J. Mulder, P. Harting, and F. C. Donders, and at Breslau by Dr. Duflos and M. Schloesser.

Among the subjects of *brevets d'invention*, we notice—

A Process of Preserving the Yolk of Eggs, patented by M. D'Andiran-Kœchlin, consisting in adding to the previously-broken-up yolks of eggs (the white being entirely separated and applied for the purposes of calico-printing), after having been dried, from 3 to 5 per cent of common salt, and one part per 1000 of arsenious acid. This yolk is not intended for food, but for the glove and wash-leather making factories; it is kept in air-tight vessels, filled without leaving any air whatever inside, and a couple of drops of pure carbolic acid are added to every litre of this homogeneous fluid.

To three gentlemen, has been granted a *brevet* for—

The Extraction of Benzine and its Homologues from Illuminating Gas obtained from Coals.—The precise process is not described; but, although it is certainly true that illuminating gas contains, by weight, ten times as large a quantity of benzine as does the coal-tar obtained at the same time, it is equally true that this benzine cannot be withdrawn from gas intended to serve the purposes of yielding good artificial light without greatly injuring its qualities in that aspect.

Improved Mode of Manufacturing Glucose from Starch.—M. Maubré.—The author states that, by the usual mode of proceeding, a portion of the starch is always left in the state of dextrine; he therefore operates under pressure and a higher temperature. For this purpose, he applies a strong cylindrically-shaped iron vessel, internally lined with lead; this boiler is charged with 28 kilos. of sulphuric acid, at 60° Beaumé, and 2800 litres of water, and this liquid is brought to the boiling point by means of high pressure steam. When boiling, there is gradually run into this fluid a mixture of 1180 kilos. of starch and 2500 litres of water, acidulated with 28 kilos. of sulphuric acid. When the whole of this quantity has been introduced into the aforesaid boiler, it is closed, and the temperature within it raised to 160°, by means of high pressure steam introduced into the boiler by leaden and perforated pipes. After about four hours, the action is complete, the fluid run off into tubs, and the acid saturated by means of 84 kilos. of finely-powdered good limestone. After separation of the sulphate of lime, the fluid is evaporated to 20° B., clarified with animal charcoal, and next evaporated in vacuum pans, yielding an excellent and beautiful glucose.

No. 301, July 1, 1869.

The only original paper contained in this number, is on the—

Platinising of Looking-Glasses.—M. Jouglet.—This paper, a very verbose and lengthy dissertation on a comparatively-speaking very trivial subject, appears to have been written with the view to bring forward a peculiar kind of manufacturing process, which, if it is attended with any improvement at all, will receive, no doubt, full justice at the hands of the public, who may be trusted to distinguish whether the covering the back of plate-glass with a thin layer of platinum is an advantage over the silvering, or amalgamating, generally applied for this purpose. The process itself does not seem to contain any novelty, and is described in this paper in a tediously-puffing style.

Cosmos, July 3, 1869.

New Dye from Madder.—Prof. Rochleder, at Prague, has found that, when madder is treated with dilute mineral acids, it yields, beside alizarine and purpurine, a small quantity of a third tinctorial substance, which, in alkaline solution, has a great similarity to chrysophanic acid dissolved in alkaline solution; acids precipitate it from this solution in the amorphous flocculent shape, the precipitate being of a pale yellow colour. This substance is soluble in alcohol and in acetic acid, and crystallises from these solutions, on the evaporation of the solvent, yielding orange-yellow coloured crystals; its aqueous solution mixed with acetic acid, and brought to boiling point, imparts to silk and wool immersed in that bath a beautiful and durable golden-yellow colour.

July 10, 1869.

This paper contains, as usual, a variety of information. The only note suitable for our readers is—

On the Seat of the Hygroscopic Properties of Silk.—M. Suida.—It is a well-known fact that crude silk is very hygroscopic; and some doubt has existed as to whether the exterior gum-like varnish of the raw silk, or the interior fibroine, was the chief seat of this great avidity for moisture. The author has taken a certain quantity of one and the same kind of silk (the avidity for moisture is by no means the same for all silks the produce even of one and the same country, and therefore it was necessary to operate upon one sample of known and the same origin), a portion of which had been deprived of its natural gum, while another portion was in its native state. The result of very carefully-instituted experiments is, that the fibroine—that is to say, the essential fibre of the silk itself, and not its tegumentary parts, gum chiefly, are the seat of the hygroscopic properties of raw non-dyed silk; the process of dyeing materially altering the fibre, also affects its hygroscopic properties. In 100 parts of silk, according to Mulder's analysis, the only extant, this substance consists of:—Fibroine, 53·37; gelatine, 20·66; albumen, 24·43; wax, 1·39; yellow colouring matter, 0·05; resinous and fatty matters, 0·10; this analysis refers to yellow (naturally coloured) silk from Naples. White native silk from the Levant was composed, in 100 parts, of—Fibroine, 54·04; gelatine, 19·08; albumen, 25·47; wax, 1·11; resinous and fatty matters, 0·30.

Bulletin de la Société Chimique de Paris, June, 1869.

From the *procès verbal* of the meeting of this society, held on the 16th of April last, we quote the following:—

M. Lefranc, a pharmaceutical chemist of the French army, presented to the Society a printed pamphlet—

On Atractylic Acid and Atractylates.—This acid is a naturally-existing compound sulpho-acid, met with in the *Atractylis gummifera* as a potassa salt; it is split up, by the action of acids, into sulphuric and valerianic acids, glucose, and a resin.

M. Tollens stated at the meeting that the well-known reaction of hypochlorite of lime and aniline is interfered with by the presence of ammonia, or any salt thereof, and that then the reaction only takes place when a large excess of chloride of lime is applied.

The following original papers are published in this number:—

Action of the Electric Spark upon Marsh Gas.

Direct Union of Free Nitrogen and Acetylene, and the Direct Formation of Hydrocyanic Acid.

Both these papers having been read by the author, M. Berthelot, also at meetings of the Academie des Sciences, have been already noticed by us; this remark equally applies to the next paper, by the same author—

Formation and Decomposition of Sulphide of Carbon.

Chemical Equilibrium, and the Influence of Pressure as Affecting the Action of Carbon and Hydrogen upon each other.—M. Berthelot.—The chief result arrived at by the author is that, when the pressure varies continuously, the equilibrium between carbon

and hydrogen changes by sudden shocks, thereby following rapports which are the multiples of the one and the other.

Essence of Sassafras.—Messers. Grimaux and Ruotte.—The essential oil of sassafras, obtained from the *Laurus sassafras*, is, when recently rectified, a colourless fluid, which, at 0° C. (32° F.), has a specific gravity of 1·0815. The oil is a mixture of a hydrocarbon and an inactive oxygen-containing principle; this latter consists, in 100 parts, of—Carbon, 74·43; hydrogen, 6·46; oxygen, 19·11. It is present in the natural oil in so small quantity that only just sufficient for a good elementary organic analysis was obtained. The hydrocarbon (safren) contains $C_{10}H_6$, and consists, in 100 parts, of—C, 88·23; H, 11·77. Its vapour density has been found equal to 4·84. Safren boils at about 156°. The oil further contains safrol, $C_{10}H_{10}O_2$, boiling at between 231° and 233°. Safrol is insoluble in water. Its specific gravity is 1·1141 at 0°; at −20° it is not frozen. The authors have studied the action of bromine, of hydriodic acid, of perchloride of phosphorus, and nitric acid upon safrol, but state that none of these reactions gave such results as they expected. With bromine, safrol yields a compound of the formula $C_{10}H_8Br_8O_2$.

Presence in the Air of Active Oxygen, or Ozone.—M. Houzeau.—The author demonstrates, at great length, in this paper that the air of the country is of a different character from that of towns; that the former is strongly disinfectant, has far greater bleaching power, and, especially after rainfall, affects bright and oxidisable metals far more than is the case in towns. This paper is not intended as a fully-demonstrative memoir, but in it the author calls attention to some facts readily observed, as, for instance, the rapid bleaching of all kinds of woven fabrics, be they made of linen, cotton, or woollen fibre; the rapid fading of very many dyed tissues; the far more active rusting of iron, steel, and even copper, in the country as compared with large towns. Curiously enough, the author does not mention the well-known fact of the effects of the air at sea, even at comparatively short distances from the shore, nor, also, the peculiar effects produced by the mountain air at no greater height than from 2000 to 6000 feet above sea-level.

Bromide and Iodide of Propionyl.—M. Sestini.—The specific gravity of the bromide of propionyl is, at 14°, equal to 1·465; its boiling point is about 97°; water decomposes it; formula, C_3H_5OBr. The iodide of propionyl boils at 127°: its specific gravity is far greater than that of water, in contact with which it is decomposed instantaneously; formula, C_3H_5OI.

Soluble Albumen which is not Coagulated by Heat.—Dr. Monnier.—We have already noticed this communication, but have to rectify the name of the author's place of residence, which is not *Lyons*, but *Nyon* (a town in the Département de Drôme); the *Deutsche Industrie Zeitung*, from which our abstract was made, had printed *Lyons*.

Use of Phosphate of Soda for Removing Manganese out of Solutions wherein Zinc has to be Estimated Volumetrically.—M. Renard.—The author states that he dissolved 1 grm. of zinc in hydrochloric acid, added thereto 0·6 grm. of chloride of manganese; next ammonia was added, and after that phosphate of soda; the result of his volumetrical estimation of zinc in this solution came to 0·998 grm. of zinc. When the addition of phosphate of soda to a solution of precisely the same composition as the one alluded to was omitted, the quantity of zinc was found to amount to 1·036 grm. The ferrocyanide of potassium process was used in these experiments.

The remaining pages of this periodical are filled with abstracts and translations from English, German, and American periodicals, and with abstracts from the *Comptes Rendus*. The large majority of these are taken from works published during the course of last year; most of them have been already noticed by us.

Journal für Praktische Chemie, No. 6, 1869.

This periodical opens with a very lengthy and exhaustive essay on the

Affinity between Solution of Acetate of Iron without Change of State of Aggregation.—Prof. A. Müller.—This memoir is subdivided into several chapters, and has a series of tabulated forms added: it is not well suited for abstraction.

Chemical Researches of the Eozoon Stone of Raspenau, in Bohemia.—Dr. R. Hofmann.—The stone here alluded to appears to be a serpentinoid mineral, embodied in a kind of dolomite, of which the composition, in 100 parts, is as follows:—Carbonate of lime, 58·815; carbonate of magnesia, 40·20; peroxide of iron, 4·291; insoluble in HCl, 1·261; water, 0·083; traces only of phosphoric acid. The shell of the eozoon stone consists, in 100 parts, of—Carbonate of lime, 97·711; carbonate of protoxide of iron, 1·660; carbonate of magnesia, a trace; alumina, 0·629; minute traces of phosphoric acid. The central portion of the inner part of the eozoon stone has a specific gravity of 2·687, and consists, in 100 parts, of—Water, 7·092; silica, 36·425; alumina, 32·944; protoxide of iron, 20·140; lime, 0·678; potassa, 2·721.

Dolomitic Limestone of Cheynov, near Tábor, in Bohemia.—Dr. R. Hofmann.—This limestone is deposited among and embedded in gneiss; it varies in composition as well as in specific gravity, the latter having been found as low as 2·711, and as high as 2·861; its extremes of composition, in 100 parts, are as follows:—Carbonate of lime, 98·418, and 57·809; carbonate of magnesia, 0·009, and 39·186; protoxide of iron, 0·346, and 0·628; peroxide of iron and alumina, none in either sample; insoluble in hydrochloric acid, 1·167, and 2·377.

Composition of Hauyn.—Prof. A. Kenngott.—This is a purely mineralogical paper.

Basic Salts of Zinc and Copper.—M. Franz Reindel.—The author says that, when a boiling solution of sulphate of zinc containing an excess of that salt is treated either with a solution of caustic or carbonated alkalies, precipitates are formed which, both in consequence of their composition and of their peculiar behaviour towards reagents, deserve the attention of chemists. It has often been stated that pure $CuOCO_2$ may be obtained by decomposing 1 equivalent of $CuOSO_3$ with 1 equivalent of $NaOCO_2$. The author has digested the mixture obtained as result of this reaction for one month with a concentrated solution of soda in the cold, and has not been able thus to obtain, even after very careful washing out, a product entirely free from sulphuric acid. The basic sulphate of zinc obtained by boiling a solution of sulphate of zinc in excess with ammonia constitutes a white powder, which, on being washed with water, is steadily but very slowly decomposed; the fluid running off from the filter has an acid reaction, and contains sulphuric acid as well as oxide of zinc. The author gives, in this lengthy and still unfinished paper, several analyses of basic salts, obtained under a variety of conditions, and dried at temperatures varying from 110° to 260°, whereby the quantity of water of these salts is reduced, but not eliminated, for some of these salts lose water up to a red heat.

Influence of Water upon some Siliceous Minerals.—M. A. Cossa.—The minerals submitted to experiment were two kinds of gneiss, ayenite, several kinds of trachyte, granite, and basalt. They were reduced to powder, and left for ten days in contact with twenty-five times their bulk of pure water, at a temperature of from 17° to 18°; the filtrates were evaporated to dryness, and, after having been moistened with hydrochloric acid, again evaporated, and the dry residue weighed as chlorides. The weight of these residues varied from 0·0567 per cent to 0·35 per cent of matter dissolved.

Annales de Chimie et de Physique, April, May, and June, 1869.

We do not separately notice each of them, for the reason that the last essay which concludes the number for May is continued through that of June, but not yet concluded.

The April number of this periodical opens with a portion of M. Friedel's essay on the Acetons and Aldehydes, which is concluded. Next we meet with a biographical notice of M. Sadi Carnot, by Le Comte Paul de Saint Robert. Next follows—

Researches on Resins.—M. Sacc.—The author observes that resins have been very little studied at all; and his researches recorded in this paper extend to copal, amber, dammar, colophony, lac (or shellac), elemi, sandarac, mastic, and carnauba wax (a resin). The author has studied the more or less degree of readiness wherewith resins are reduced to powder, the action thereupon of boiling water, of alcohol of 86 per cent strength, of ether, of ordinary acetic acid, of a hot solution of caustic soda of 1·074 specific gravity, of sulphide of carbon, of oil of turpentine, of boiled linseed oil, of benzine, of naphtha, of sulphuric acid of 1·83 specific gravity, of nitric acid of 1·329 specific gravity, and of caustic ammonia. All resins were applied in powdered state; and the solvents three times as large a bulk as that of the resins have acted for at least twenty-four hours, at temperatures varying between 15° and 22°. The general results arrived at are briefly as follows:—All resins submitted to experiments fuse quietly when heated, excepting amber, shellac, elemi, sandarac, and mastic, which swell up, and increase in bulk. Only the carnauba wax melts in boiling water; colophony becomes pasty therein, while dammar, shellac, elemi, and mastic agglutinate. Copal, amber, and sandarac do not change. Alcohol does not dissolve amber nor dammar; agglutinates copal, partly dissolves elemi and carnauba wax; while colophony, shellac, sandarac, and mastic are readily soluble therein. Ether does not dissolve amber and shellac; makes copal swell, and partly but slowly dissolves carnauba wax; dammar, colophony, elemi, sandarac, and mastic are readily dissolved therein. Acetic acid does not dissolve amber and shellac; causes copal to swell; somewhat acts upon carnauba wax, and does not at all act upon any other of the resins above named. Caustic soda solution readily dissolves shellac, difficultly colophony, and has no action upon the rest. In sulphide of carbon, amber and shellac are insoluble: copal swells therein; elemi, sandarac, mastic, and carnauba wax are difficultly dissolved therein, while dammar and colophony are readily so. Oil of turpentine has no action upon amber or shellac; causes copal to swell up; dissolves readily dammar, colophony, elemi, sandarac, carnauba, and very readily mastic. Sulphuric acid does not dissolve carnauba wax; all other resins are dissolved and coloured brown, excepting dammar, which becomes bright red. Nitric acid does not act upon the resins, but colours carnauba wax straw-yellow, elemi a dirty yellow, and mastic and sandarac bright brown. Ammonia does not dissolve some of these resins, but causes copal, sandarac, and mastic first to swell, afterwards dissolving them; colophony is easily soluble therein.

Researches on the Composition and Structure of Meteorites.—M. S. Meunier.—A very interesting and elaborate essay on this subject, but too long for proper abstraction.

On a Pump provided with a Free Plunger (*pompe à piston libre*).—M. le Marquis de Montrichard.—A physico-mechanical paper.

Pyro-Electric Properties of Crystals which are Good Conductors of Electricity.—M. C. Friedel.—The abstraction of this paper, without the re-production of the large number of woodcuts essentially belonging thereto, would be useless.

Nitriles of the Fatty Acids.—M. A. Gautier.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, April, 1869.

We notice the following original papers:—

On Cytisin, an Alkaloid of the Genus Cytisus.—Dr. A. Husemann.—The seed, bark, and root of the well-known laburnum tree (originally from Switzerland, but now dispersed throughout Europe), *Cytisus laburnum*, L., contains, it appears, an alkaloid, which has been isolated by the author, and is described by him as a white crystalline solid substance, of bitter and somewhat caustic taste, soluble in water and alcohol, and hardly soluble at all in ether, chloroform, benzol, and sulphide of carbon. Cytisin is a strong basic substance, precipitating many metallic combinations from their solutions, and setting free ammonia from its compounds. Its composition, in 100 parts, is:—C, 73·84; H, 8·30; N, 12·92; O, 4·94; formula, $C_{20}H_{27}N_3O$. The nitrate of cytisin is a readily-crystallisable salt.

The other original paper is one belonging strictly to botany. Among the miscellaneous papers met with in this periodical, we meet with a communication—

On the Varieties of Tapioca and Sago Prepared in the Malaccas.—It appears that, at the request of the resident Governor of the Malacca Islands, researches have been instituted concerning this food, at the Laboratory, at Welte Vreden, Java. The authors of this paper, MM. Maier, Moens, and Scharlec, found that three varieties of sago, denominated white, red, and blue, contain, respectively—water, 16·14, 18·83, and 18·47 per cent; protein compounds, respectively—3·7, 2·5, and 2·4 per cent; starch, fat, &c., respectively—79·88, 78·06, and 78·15 per cent; ash, respectively—0·22, 0·62, and 0·94 per cent.

The remainder of the miscellaneous in this number are of no special interest to our readers.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 137, May 15, 1869.

The original papers of this number of this periodical are confined to—

A Note on the Aurora Borealis of the 15th of April, 1869.

On Berberis Vulgaris.—M. Schnetzler.

Experimental and Theoretical Researches on the Equilibrium Figures of a Liquid Mass not Possessed of any Weight.—M. Plateau.

No. 138, June 15, 1869.

This periodical contains an astronomical paper, unsuitable for abstraction here, and no other original papers: being filled with translations of memoirs taken from *Poggendorff's Annalen*, and other periodicals of that description, the papers having been alluded to and quoted by us already.

Chemisches Centralblatt, No. 20, May 19, 1869.

This number does not contain any original papers or communications.

Bayerisches Industrie und Gewerbeblatt, March and April, 1869.

The greater part of this double number is filled with "Dasr Berggesitz für das Königreich Bayern"—that is to say, a very lucidly and perfectly-made law (act of parliament) for the regulation of everything connected with mining, quarrying, and the extraction, from the earth, of minerals, including coal, limestone, and also building materials, &c., for the kingdom of Bavaria.

Boring of Wells, and the Water Supply to Large Towns.—M. Kieser.—This is a rather lengthy, but highly interesting, essay, on a subject of very great importance.

Experiments on the Bleaching of Wood Pulp for Paper Manufacture.—Dr. C. Winkler.—Neither chlorine, bromine, nor any substances the activity of which is due to oxidation, were found by the author to answer the purpose, the result always being the production of a decidedly yellow, and sometimes even brown, tinge. Sulphurous acid does not completely answer the purpose; the destruction of the natural colouring matters by means of fermentation did not lead, also, to any good result.

Effect of Temperature of the Air upon the Illuminating Power of Burning Coal Gas.—M. A. Vogel.—From this lengthy essay we only notice that, when the illuminating power of ordinarily good coal gas is equal to 100 at 18°, it is only 76 at 0° and 33 at −20°.

May, 1869.

This number chiefly contains officially-published matter, among which are very minute directions for the assay of gold and silver articles of *bijouterie* and the use of proof or touch needles in testing the quality of pure gold and silver contained in articles presented for assay to the parties appointed for this purpose; all such assayers have to pass a very strict examination in general and practical chemistry, and especially in the assay of gold and silver by the dry, and also the wet process, as far as the latter metal is concerned. The touch-needles alluded to are made at the Munich mint, uniformly for the seven assay districts into which the kingdom of Bavaria is divided. This number does not contain any original papers relating to chemistry, or sciences closely related thereto.

NOTES AND QUERIES.

Isinglass.—Can any of your correspondents inform me of any method of obtaining isinglass, by mixture or otherwise, in the form of a powder.—ICTHYOC.

Crystallisation of Supersaturated Solutions.—Will any of your courteous readers kindly furnish an enquirer, who is greatly interested in the subject, with a list of the bodies which are found to act as nuclei in determining the crystallisation of supersaturated solutions?—R. C. C.

Water Analysis.—I have just finished examining a spring well in the country, and found on evaporating one imperial gallon of the water to perfect dryness, the residue weighed 102 grains, and afterwards ignited and lost by ignition 40 grains. Besides, I found there exists 10 grains N_2O_5 in one gallon. Now I should like to know if it is the rule to deduct the whole, or only a part of this nitric acid, from the loss by ignition when drawing up a report, or how should I act?—J. WALLACE.

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1817. K. Brown, Glasgow, N. B., "Improvements in the manufacture of iron."—Petition recorded, June 14, 1869.

1832. W. Smith, Bathgate, Linlithgow, N. B., "Improvements in heating or purifying mineral oils."—June 18, 1869.

1855. T. Routledge, Ford Works, near Sunderland, "Improvements in the preparation of materials for the manufacture of paper."—June 16, 1869.

INVENTIONS PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF COMPLETE SPECIFICATIONS.

1850. G. W. Fox, Manchester, "Improvements in the treatment of castor, cod-liver, and other medicinal oils, in order to render the same more palatable."—Petition recorded, June 16, 1869.

1868. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved process for preparing sulphates, and obtaining fine silver therefrom."—A communication from F. Gutzkow, San Francisco, California, U. S. A., June 17, 1869.

1884. H. A. Bonneville, Chaussée d'Antin, Paris, "Compounding and applying certain compounds, to render fabrics water repellent."—A communication from R. O. Lowry, Salem, Washington, N.Y., U.S.A.—June 19, 1868.

NOTICES TO PROCEED.

426. G. F. Ansell, Bernard Street, Russell Square, Middlesex, "Improvements in the manufacture of steel and iron."—Petition recorded, February 11, 1869.

434. H. Edwards, Staple Inn, Holborn, Middlesex, "An improved preserved food."—February 12, 1869.

469. L. N. Legras, Wardour Street, Middlesex, "Improvements in the preservation and disinfection of animal and other substances, and in the apparatus employed therein."

477. F. Walton, Staines, Middlesex, "Improvements in the manufacture of artificial leather."—February 16, 1869.

540. W. Ibotson, New Inn, Strand, London, W. W. Ladelle, Wraysbury, Bucks, and A. G. Southby, Bulford House, near Amesbury, Wilts, "An improved method of, and apparatus for, preparing esparto, straw, rags, or other materials for the manufacture of paper."—February, 22, 1869.

781. J. Thomlinson, Carlisle, Cumberland; and W. Thomlinson, Loughborough, Leicestershire, "Improvements in the manufacture of paper and textile fabrics, and in the preparation of gypsum, to be used in such and other manufactures."—March 13, 1869.

836. J. Thomas, Middlesborough-on-Tees, W. Bacon, Newcastle-upon-Tyne, and H. Groves, Redcar, Yorkshire, "Improvements in the manufacture of iron and steel, and in furnaces and apparatus employed therein."—March 19, 1869.

1202. L. Goetz, Leith, N.B., "An improved preparation of materials for cleansing wool, cotton, linen, and other like fibrous substances."—A communication from G. Müller, Neussadt-on-the-Haardt, Bavaria—April, 20, 1869.

1721. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of iron."—A communication from J. Burt Detroit, Michigan, U.S.A.,—June 3, 1869.

1800. G. W. Oliver, Liverpool, "Improvements in the manufacture of explosive powder, and in machinery to be used in such manufacture."—A communication from P. A. Oliver, New York, U.S.A.—June 10, 1869.

ERRATA.—In 502, July 9th, p. 13, line 27, from the top, *for* [illegible] *read* philologist; p. 13, line 28 from the top, *for* [illegible] *read* physiologist; p. 14, line 24 from the top, *for* κινησ[illegible] *read* κινησις.

THE CHEMICAL NEWS.

VOL. XX. No. 504.

RESEARCHES ON VANADIUM.*

By HENRY E. ROSCOE, B.A., Ph.D., F.R.S.

PART II.

On the Chlorides of Vanadium and Metallic Vanadium.

IN the first part of these researches ("Bakerian Lecture," *Phil. Trans.*, 1868, pt. i.) the author stated that the chlorides of vanadium, and probably also the metal itself, could be prepared from the mononitride, the only compound of vanadium not containing oxygen then known. The process for obtaining the mononitride described in the last communication was that adopted by Berzelius for preparing the substance which he conceived to be metal, but which, in reality, is mononitride. This method consists in the action of ammonia on the oxitic chloride; but it cannot be employed for the preparation of large quantities of nitride, owing to the violence of the action and consequent loss of material. The author, seeking for a more economical method, found that if the ammonium metavanadate (NH_4VO_3) be heated for a sufficiently long time at a white heat in a current of dry ammonia, pure vanadium mononitride remains behind. Analysis of a sample thus prepared gave 79·6 per cent of vanadium and 20·2 per cent of nitrogen, theory requiring 78·6 and 21·4 per cent respectively. The mononitride may likewise be directly prepared by igniting vanadium trioxide (V_2O_3) in a current of ammonia at a white heat in a platinum tube, and also by subjecting the dichloride to the same treatment.

The Chlorides of Vanadium.—Three chlorides of vanadium have been prepared, viz.:—

Vanadium tetrachloride ..	VCl_4
Vanadium trichloride ..	VCl_3
Vanadium dichloride.. ..	VCl_2

1. *Vanadium Tetrachloride*, VCl_4, molec. wt. = 193·3, V.D. = 96·6 (H = 1).—This chloride is formed as a dark reddish brown volatile liquid, when metallic vanadium or the mononitride is burnt in excess of chlorine. The first method adopted for the preparation of this chloride was to pass dry chlorine over the mononitride heated to redness; the whole of the nitride volatilises and a reddish brown liquid comes over. In one operation 44 grains of the crude tetrachloride was thus prepared; the liquid is purified by distillation, first in a current of chlorine and then in a stream of carbonic acid gas. On fractionating, the liquid was found to boil at 154° C. (corrected) under 760 m.m. of mercury. The second method depends upon a fact already noticed in the preceding communication, that the oxitrichloride ($VOCl_3$), prepared, according to the directions of Berzelius, by passing dry chlorine over a mixture of the trioxide and charcoal, possesses a port-wine colour instead of the canary-yellow tint of the pure substance. This dark colour is due to the formation of the tetrachloride of vanadium, and if the vapours of the oxytrichloride, together with excess of dry chlorine, be passed several times over a column of red-hot charcoal the whole of the oxygen of the oxychloride can be removed, and at last perfectly pure tetrachloride, boiling constantly at 154°, is obtained. This reaction, it will be remembered, served first to demonstrate the existence of oxygen in the oxytrichloride. In each distillation of the tetrachloride a peach-blossom coloured solid residue remained in the bulbs; this substance is vanadium trichloride, and it slowly burns away in excess of chlorine when heated, forming tetrachloride.

The composition of the tetrachloride was established by six well-agreeing analyses, made from several different preparations. The mean result is:—

	Calculated.	Found.
V = 51·3 ..	26·54 ..	26·87
Cl_4 = 142·0 ..	73·46 ..	73·02
193·3	100·00	99·89

Owing to the facility with which the tetrachloride splits up into trichloride and chlorine, a solid residue was left in the vapour-density bulb, and the density of the vapour (at 219°) was found by Dumas's method to be 99·06 (or 6·86) instead of 96·6 (or 6·69). By volatilising the liquid in a small bulb, and allowing the vapours to pass into a large bulb already heated above the boiling-point of the liquid, this deposition of trichloride was avoided, and the density was found to be 96·6 or 6·69 at 205°, and 93·3 or 6·48 at 215°, the last determination indicating that a partial decomposition into VCl_3 and Cl had occurred. The specific gravity of the liquid tetrachloride at 0° is 1·8584; it does not solidify at −18°, nor does it at this or any higher temperature undergo change of properties on treatment with chloride. It not only undergoes decomposition on boiling, but at the ordinary atmospheric temperatures it splits up into VCl_3 and Cl. Tubes in which the liquid chloride had been sealed up have burst by the pressure of the evolved chlorine. Thrown into water, the tetrachloride is at once decomposed, yielding a blue solution identical in colour with the liquid obtained by the action of sulphurous or sulphydric acids on vanadic acid in solution, and containing a vanadous salt, derived from the tetroxide V_2O_4. In order to prove that a vanadous salt is formed when the tetrachloride is thrown into water, the solution thus obtained was oxidised to vanadic acid by a standard permanganate solution. The calculated percentage of oxygen thus needed, according to the formula

$$2VCl_4 + O + 4H_2O = V_2O_5 + 8HCl$$

is 4·14; the percentage of oxygen found by experiment was 4·11.

The solution of the tetrachloride in water does not bleach; but if the vapour be led into water a liquid is obtained which bleaches litmus. Vanadium tetrachloride acts violently on dry alcohol and ether, forming deep-coloured liquids. The author is engaged upon the examination of this reaction.

Bromine and vanadium tetrachloride, sealed up and heated together, do not combine; on the contrary, trichloride is deposited. Hence it is clear that vanadium does not readily form a pentad compound with the chlorous elements.

2. *Vanadium Trichloride*, $VCl_3 = 157·8$.—The trichloride is a solid body, crystallising in splendid peach-blossom coloured shining tables, closely resembling in appearance the crystals of chromium sesquichloride. It is non-volatile in hydrogen, and, when heated in the air, it decomposes, glowing with absorption of oxygen, and forming the pent-oxide. Heated in hydrogen, the trichloride first loses one atom of chlorine, forming the dichloride (VCl_2), and afterwards, on exposure to a higher temperature, loses all its chlorine, leaving metallic vanadium as a grey lustrous powder. The trichloride is extremely hygroscopic, deliquescing on exposure to air to a brown liquid. The trichloride is best prepared by the quick decomposition of the tetrachloride at its boiling point, or by its slow decomposition at the ordinary temperature of the air. The crystalline powder obtained by either of these methods only requires freeing from adhering tetrachloride, by drying in carbon dioxide at 160°, in order to yield good analytical results.

* Abstract of a paper read before the Royal Society, June 17, 1869.

		Calculated.	Mean of 4 analyses.
V	= 51·3	.. 32·5	.. 32·57
Cl_3	= 106·5	.. 67·5	.. 67·42
	157·8	100·0	99·99

The trichloride thrown into water does not at once dissolve; but, as soon as the crystals get moistened, a brown solution is formed, which becomes green on addition of a drop of hydrochloric acid, and contains a hypovanadic salt in solution. This green tint is identical with that got by reducing a solution of vanadic acid in presence of magnesium. According to the equation—

$$2VCl_3 + O_2 + 3H_2O = V_2O_5 + 6HCl$$

the solution of the trichloride requires 10·14 per cent of oxygen to bring it up to vanadic acid, whilst analysis showed that 10·1 per cent was necessary. The specific gravity of the trichloride at 18° is 3·00.

3. *Vanadium Dichloride*, VCl_2 122·3.—The dichloride is a solid, crystallising in fine bright apple-green micacious plates. It is prepared by passing the vapour of vanadium tetrachloride mixed with hydrogen through a glass tube heated to dull redness. If the heat be pushed further, a blackish crystalline powder, consisting of a mixture of lower chloride and metal, is obtained. The dichloride, when strongly heated in hydrogen, loses all its chlorine, leaving vanadium in the metallic state in grey crystalline grains. Analysis gave:—

		Calculated.	Mean of 2 analyses.
V	= 51·3	.. 41·95	.. 42·16
Cl_2	= 71·0	.. 58·05	.. 57·88
	122·3	100·00	100·00

Vanadium dichloride is extremely hygroscopic; when thrown into water, a violet-coloured solution is formed, identical in tint with the liquid containing a hypovanadous salt obtained by reducing vanadic acid in solution in presence of zinc- or sodium-amalgam; and like this latter liquid, the solution of dichloride in water bleaches strongly by reduction.

Oxidised by permanganate, this liquid required 18·78 per cent oxygen (on the dichloride taken) to bring it up to vanadic acid, whereas the equation—

$$2VCl_2 + O_3 + 2H_2O = V_2O_5 + 4HCl$$

requires 19·6 per cent. The specific gravity of vanadium dichloride at 18° is 3·23.

Metallic Vanadium, V 51·3.—Although from what we know of the characters of vanadium, it appeared unlikely that any compound containing oxygen would yield the metal by direct reduction, the author has repeated the experiments of other chemists on this subject, but without success. There is no doubt that the metal cannot be obtained by any of the processes described in the books. The only methods which promised possible results were:—

1. The reduction of a vanadium chloride (free from oxygen) in hydrogen gas, either with or without sodium.
2. The reduction of the mononitride at a white heat in hydrogen.

The first of these methods has proved to be successful, whilst the second does not appear to yield metal, inasmuch as the nitride exposed for 3½ hours in a platinum tube to the action of hydrogen at a white heat, lost only 8 per cent, whereas it must lose 21·4 per cent on conversion into metal.

Notwithstanding the apparent simplicity of the method, the author has found it exceedingly difficult to obtain the metal perfectly free from oxygen. This arises from the fact that, whilst vanadium is quite stable at the ordinary temperature, it absorbs oxygen with the greatest avidity at a red heat, and that, therefore, every trace of air and moisture must be excluded during the reduction. Another difficulty consists in the preparation of the solid chlorides in large quantity and free from oxygen or moisture, as also in the length of time needed to reduce these chlorides in hydrogen, during which time unavoidable diffusion occurs, and traces of oxygen enter the tube. Again, the reduction can only be effected in platinum boats placed in a porcelain tube, as the metal acts violently on glass and porcelain, and tubes of platinum are porous at a red heat.

A description of the apparatus employed is then given, the main points being to guard against diffusion, and to introduce the powdered dichloride into the platinum boat in such a way that it shall not for an instant be exposed to moist air. After all precautions are taken, the tube is heated to redness, torrents of hydrochloric acid come off, and the evolution of this gas continues for from 40 to 80 hours, according to the quantity of dichloride taken. After every trace of hydrochloric acid has ceased to be perceptible, the tube is allowed to cool, and the boat is found to contain a light whitish grey-coloured powder, perfectly free from chlorine.

Metallic vanadium thus prepared, examined under the microscope, reflects light powerfully, and is seen to consist of brilliant shining crystalline metallic mass, possessing a bright silver-white lustre. Vanadium does not oxidise or even tarnish in the air at the ordinary temperature; nor does it absorb oxygen when heated in the air to 100°. It does not decompose water even at 100°, and may be moistened with water, and dried *in vacuo*, or at 100°, without gaining weight. The metal is not fusible or volatile at a bright red heat in hydrogen; the powdered metal thrown into a flame, burns with the most brilliant scintillations. Heated quickly in oxygen, it burns vividly, forming the pentoxide; but slowly ignited in air, it first glows to form a brown oxide (possibly V_2O), and then again absorbs oxygen, and glows with formation of the black trioxide and blue tetroxide, till it at last attains its maximum degree of oxidation. The specific gravity of metallic vanadium at 15° is 5·5. It is not soluble in either hot or cold hydrochloric acid; strong sulphuric acid dissolves it on heating, giving a yellow solution; hydrofluoric acid dissolves it slowly with evolution of hydrogen; nitric acid of all strengths acts violently on the metal, evolving red nitrous fumes, and yielding a blue solution: fused with sodium hydroxide, the metal dissolves with evolution of hydrogen, a vanadate being formed.

One sample yielded on oxidation a percentage increase of 77·94, whereas that calculated from metal to pentoxide is 77·98. Another preparation gave a percentage increase of 70·8, showing the presence of a small quantity of oxide. On treatment in a current of chlorine, metallic vanadium burns and forms the reddish black tetrachloride; heated in a current of pure nitrogen, the mononitride is formed.

The properties of the compounds of vanadium with silicon and platinum are then described in the memoir.

ON

COLOPHONINE AND COLOPHONIC HYDRATE,

NEW SUBSTANCES PROCURED FROM THE PRODUCTS OF THE DESTRUCTIVE DISTILLATION OF RESIN.*

By CHARLES R. C. TICHBORNE, M.R.I.A., F.C.S., &c.

When we submit to distillation (either with or without water) the natural exudations of the different pines, the first result is the extraction of volatile hydrocarbons, or oils of turpentine. These oils were, until very lately, considered as identical, but recent investigations have proved that there is a considerable disparity in the products from different species of the pines. If, after the extraction of the volatile oils, the distillation is pushed further, we get a second series of volatile compounds, which, however, differ materially from the first, inasmuch as they are de-

* Communicated by the author. Read before the Royal Irish Academy.

composition products, resulting from the splitting up of the colophony, or resinous part, into more simple molecules of different isomeric modifications.

All the resin oils obtained by myself gave the result I am now about to detail. I, however, believe that the discrepancies exhibited by the turpentines are perpetuated through the products obtainable upon the destructive distillation of the resins proper to such turpentines.

My attention was first directed to the substance which I have named colophine from an observation made preparatory to investigating the volatile oils procured on submitting resin to destructive distillation.

I took commercial resin, and, after drying for some time at a slightly elevated temperature, distilled it in an iron retort. I got, by this means, a thick distillate, which contained a considerable quantity of undecomposed resin. Gaseous products escaped which are said to contain ethylene, tetrylene, and marsh gas. The liquid products amounted to about 74 per cent of the resin employed, and a small coke was left in the retort. This thick oil, on rectification, gave about 5 to 6 per cent of a light yellow but mobile fluid, which is known under the names of "resin spirit," "vive essence," "Harzessenz."*

This lighter portion, or "resin spirit," is supposed to consist mainly of the hydrocarbons homologous of the series $C_n H_{2n-4}$ and $C_n H_{2n-6}$, and an oxygenated oil, which has been named colophonone.† It is these light oils that yield colophonic hydrate. They act energetically upon the fluid alloy of potassium and sodium, even when free from the last-named substance; therefore it is probable that colophonone, or other oxygenated oils, form a large ingredient.

It is given as a specific characteristic of colophonone, that, if it is treated with sulphuric or hydrochloric acid, a green oil separates on the addition of water. This is, however, only partially true; for I found that the "resin spirit"‡ procured in the above experiment, or old resin spirit that had been washed, only gave this reaction in a slight degree.

It was, therefore, evident that the colour-phenomenon was due to the presence of some other substance soluble in water, and not to a specific property of the colophonone. On treating old resin spirit with distilled water two or three times, and on evaporating these washings at a low temperature, a brown crystalline mass was procured, which gave the colour-reactions, hitherto attributed to the oil itself, in a most vivid manner. It therefore becomes evident that the whole subject of colophonone requires revision. It was probable that the substance analysed under that name was a mixture.

I subsequently obtained specimens of the new substance in which individual crystals had attained some considerable magnitude.

Some of them were 3 centimetres long, and over 2 grammes in weight. They were of an amber colour, from impurities, and were obtained by submitting a large volume (10 litres) of the spirit, in an imperfectly-closed vessel, to twelve months' slow evaporation and oxidation. I have procured as much as 281 grammes of the crude crystals from 4·5 litres of resin spirit by washing.

The following are the characteristics of this compound, which, when purified, is a truly beautiful substance:—

Colophonic hydrate is white, perfectly odourless, and has a sweetish taste; it is very soluble in water, alcohol, ether, chloroform, and tetrachloride of carbon; not quite so soluble in cold benzole and resin spirit, but slightly soluble in cold bisulphide of carbon.

Colophonic hydrate crystallises readily from water or alcohol, in beautiful acicular prisms, which sometimes attain some magnitude. Heated, it melts and sublimes, with a partial loss of the elements of water. The crystals which first sublime lose water, but nearly resemble those obtained from a solution, both as regards their appearance and composition. Those which afterwards rise or if the first are re-sublimed lose more water and form hexagonal plates, or fern like fronds, of great beauty. It was impossible to accurately measure the large crystals already mentioned, the twelve months immersion having rounded and worn the faces, from the rise and fall of temperature in the medium in which they are formed. They seem to belong to the dimetric system, and are the result of the combination of the two prisms of that system.

The hydrated crystals, when placed over sulphuric acid, or *in vacuo*, gradually lose water, and effloresce; but, as the substance is itself volatile, the loss could not be measured under such circumstances. When placed under a bell-glass over sulphuric acid, the surface of the acid becomes covered with a green film, produced, as will be afterwards explained, by the mutual action of the water, sulphuric acid, and colophonic hydrate. Some difficulty was experienced in procuring the anhydrous compound. From the above results, it was supposed that, on submitting the hydrate to sublimation, the water of hydration would be dissociated. Such, however, was not the case, and a combustion of the sublimed crystals pointed to no formula. The sublimate was, in fact, a mixture of the anhydrous and hydrated compounds.

The first of these substances I obtained in the following manner:—I gently fused, in a test-tube, for some time the crystals obtained from an aqueous solution, occasionally drying out the moisture which condensed at the top of the tube with bibulous paper. The sublimed crystals were repeatedly broken down, and mixed with the fused mass. This process was continued as long as moisture was given off. I retained the crystalline mass for analysis. It seemed to have suffered no decomposition, exclusive of dehydration, and formed a friable and nearly perfectly white substance.

On making a combustion of the above, 0·218 gramme gave 0·505 gramme CO_2, and 0·218 gramme H_2O.

In a second experiment, 0·307 gramme of the fused mass gave 0·7076 gramme of CO_2, and 0·324 gramme of H_2O.

These experiments point to the empirical formula $C_{10}H_{22}O_3$.

	I.	II.	Theory.	
Carbon	63·16	62·86	63·15	120
Hydrogen ..	11·10	11·72	11·58	22
Oxygen			25·27	48
			100·00	190

The crystals obtained from an aqueous solution gave, when burnt, the following results:—0·265 gramme of crystals produced 0·557 gramme of CO_2, and 0·270 gramme of H_2O.

		Theory.	
Carbon	57·35	57·70	120
Hydrogen ..	11·32	11·53	24
Oxygen ..		30·77	64
		100·00	208

Colophonic hydrate .. $C_{10}H_{22}O_3 : H_2O$.
Colophonine .. .. .. $C_{10}H_{20}O_2$.

Colophonine is, therefore, isomeric with terpine hydrate, or is, more properly, a homologue of terpine. It is another instalment towards filling up an interesting series. This compound is probably derived from terebene.

* Mr. J. Turner, a large distiller of resin, has kindly sent me the following notes regarding the statistics of the production of these oils on a manufacturing scale:—

	Percentage.
"Resin spirit" (boiling at 135° C.)	5·0
Heavy oils	64·0
Pitch	14·4
Gaseous products and H_2O	15·7

† Schiel.

‡ I shall use the term "resin spirit" throughout this paper, to designate the light oils got on rectifying resin oils.

Hydrocarbides.	Products formed therefrom by the occult molecule H_2O ("Turpentine Camphors.")	Hydrates.
$C_{10}H_{16}$, $C_{10}H_{16}$. ("Diterebene.")	$C_{10}H_{16}$, $C_{10}H_{16}$; H_2O.* ("Terpinole.")	
$C_{10}H_{16}$. (α) (Turpentine, or "terebenthene.")	$C_{10}H_{16}$; H_2O ("Liq. Turpentine Camphor.")	$C_{10}H_{16}$; H_2O : H_2O. Hypothetical hydrate, supposed transition products.
	$C_{10}H_{16}$; $2H_2O$. ("Terpine.")	$C_{10}H_{16}$; $2H_2O$: H_2O. (Terpine hydrate.)
$C_{10}H_{16}$. (β) ("Terebene.")	$C_{10}H_{16}$; $3H_2O$. (Colophonine.)	$C_{10}H_{16}$; $3H_2O$: H_2O. (Colophonic hydrate.)

In the above table, I have endeavoured to convey, by the punctuation, the accretion of the series, and the different degrees of molecular integration.

It will be observed that each hydrate would be isomeric with the next higher homologue in the camphor series. The hydrates to the first two in the series are wanting, but it is probable that they exist, as the compound called liquid turpentine camphor is, in the presence of water, converted into terpine, the isomer of its hydrate. If we do not suppose that the hydrate is first formed, we could hardly account for the formation of terpine.

Colophonic hydrate was violently acted on by bromine, accompanied by a copious separation of carbon and hydrobromic acid. In water, the action was more manageable, and the ultimate product was a brominated oil, which, after washing, first with a diluted solution of carbonate of sodium and then with water, was dried over sulphuric acid. 0·471 gramme of this oil, after being decomposed in a sealed tube with pure soda, was treated with an excess of nitric acid, and nitrate of silver. It gave 0·766 gramme of bromide of silver, agreeing very nearly with the formula of a tetrabrominated compound.

Professor Jellett, who kindly examined this substance for me as regards its optical properties, finds that it is perfectly inert when in solution, and possesses neither right nor left-handed rotation.†

As previously stated, the light oils from resin when treated with sulphuric acid, and then with water, produce a green substance. This colouration is, however, due to the presence of colophonic hydrate. On treating that compound with acids, a series of striking phenomena is exhibited, conjugated acids being formed, which exhibit a fine display of colours. The generality of these are green. Sulphuric, phosphoric (monobasic and tribasic), arsenious, citric, and tartaric acids give these reactions.

On treating the crystals with an excess of the acid, and then adding spirit, the colour is developed. It is necessary to use heat in most cases. The sulphuric acid reaction is capable of rendering evident a milligramme of the new substance, if properly applied. It is not necessary to use heat in this case. Under certain circumstances, hydrochloric acid is capable of producing this green reaction; but when colophonic hydrate is treated with an excess of strong hydrochloric acid, after the expiration of half-an-hour, a brilliant rose colour is developed on pouring it into alcohol. If the experiment is pushed further, different shades of violets are produced, until the ultimate result of the maceration is a magnificent indigo blue.

Terpine hydrates do not give any of these reactions. The coloured solutions give absorption spectra, represented by the accompanying diagram. The longitudinal lines *A*, *a*, *B*, *C*, &c., represent the position of the solar lines. The thickness of the dark bands represent intensity of absorption, in a similar manner to Bunsen's graphic method used for metal spectra. Fig. 1 is the spectrum seen on viewing an alcoholic solution of the sulphuric compound. Dr. Reynolds, to whom I showed this spectrum, noticed that, when the acid is first mixed, the spectrum shows an absorption between the lines *D* and *E*, β, Fig. 1; this, however, after a little time, begins to fade from its more refrangible end, the centre of the spectrum gradually clearing, until the band is lost, and the spectrum, Fig. 2, obtained, the band *a*, *a'*, being intensified. Hydrochloric acid spectra behave in a somewhat similar manner, the ultimate result, either from age or boiling, being a spectrum similar to Fig. 3, the bands *a*, *a'*, slowly fading. These results would lead to the inference that the normal colour is purple, which is afterwards converted into the green compound.

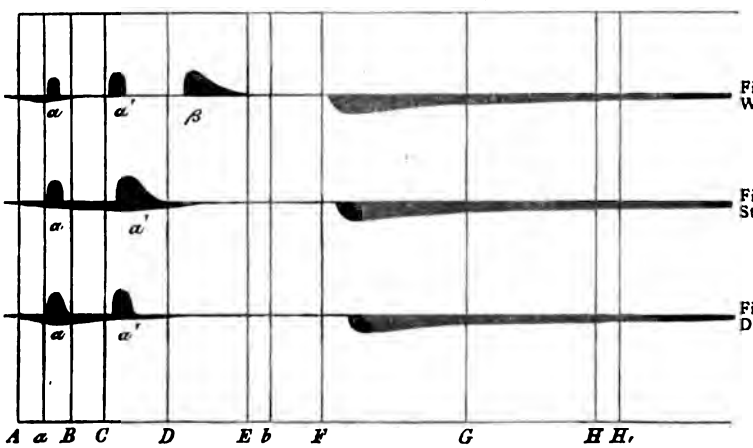

Fig. 1. H_2SO_4, or HCl. When first mixed.

Fig. 2. H_2SO_4. Strong alcoholic solution.

Fig. 3. H_2SO_4. Diluted alcoholic solution.

As regards the origin of colophonic hydrate, it is probably formed under similar circumstances to the terpine camphors, *i.e.*, by oxidation, or the assimilation of the elements of water. I have failed, however, in forming this substance artificially by oxidising the resin spirit with nitric acid.*

It is not present in newly-prepared resin spirit, as I have already explained; and, as my supply of colophonic hydrate was expended, my researches upon this substance were, I am sorry to say, brought to a close. It is, however, my intention to renew them at a future period.

* Formed by the action of dibromhydrate of citrene on acetate of silver—

$$2(C_{10}H_{16}Br_2)+4(C_2H_3AgO_2)-4(AgBr)-2(C_2H_4O_2)-\left.\begin{matrix}C_2H_3O\\C_2H_3O\end{matrix}\right\}O=$$
$$=C_{20}H_{34}O.$$
(Terpinole.)

Vide "Naquet's Principles," p. 396.

† It does not differ in this respect from its congeners the terpine hydrates, and similar products, in which, although the hydrocarbide preserves its integrity, its gyratory power is suspended.

* Mr. Turner forwarded me from England a bottle containing resin spirit, in which he had observed crystals. They proved, on examination, to be colophonic hydrate. The bottle originally contained about 8 ounces, but, from evaporation, only ½ an ounce remained; it consisted of about 25 per cent of colophonic hydrate. It had been exposed to sunlight for about eight years—light, however, is not essential to the formation of this compound.

CONTRIBUTIONS TO OUR KNOWLEDGE OF

NATURAL WATERS USED FOR DRINKING AND OTHER DOMESTIC PURPOSES.

WHATEVER can serve for the purpose just named cannot but be highly acceptable at a time when the question of water supply, purity of water, and the origin therein of substances deemed by some injurious, and indicating its contamination with the products of the decomposition of animal matter, is daily discussed. It is not our intention to enter upon speculative ground, but we will simply place before our readers a few facts, relating to the natural history of various kinds of water investigated by the Royal Committee appointed for the purpose of making a thorough inquiry into all matters relating to potable waters, and those used for domestic purposes, in the kingdom of the Netherlands, which facts, including chemical analysis, microscopic investigation of sediments, engineering, and geological matters, have been embodied in a printed report. We have selected those samples of water which, for their peculiarities in some respect or other, are best fit to bear especially also upon the question *how* and *whence* ammonia and nitrates, as met with in natural waters, are derived.

We have to call attention first to some facts which are, especially in this country, rather overlooked; to wit – (1) that, although the larger portion of the Netherlands territory in Europe is of comparatively very recent geological formation and consists of strata of very great permeability for water, that permeability exists in almost all kinds of geological formations, and, therefore, in all countries, hence the water of rivers, lakes, sea and other water-courses penetrates, to greater or less extent and depth, into the soil and contributes with the water fallen as rain and snow to fill the springs and more or less deep wells.

The second observation relates to an essential difference in the primitive source of the water of the British rivers as compared with, for instance, that of the Rhine; for the sake of illustrating what we mean, we will just briefly quote a few facts and figures, first about the Rhine, and next about the Thames. The Rhine has its sources in that portion of the Swiss Alps called the St. Gothard group, at an elevation above sea level of 9,967 feet; it is fed by the constantly melting ice and snow of the higher peaks of the Alps, and its three main constituent rivulets flow into one at Reichenau, at a height of 2021 feet above sea level; thence to the lake of Constanz or Bodensee the river takes its course over a hard, rocky bed; it traverses the lake just named, which, by-the-by, is exceedingly deep, and contains water of great purity. The direct course of the Rhine has a length of 415 miles, its basin has an area of 65,280 square miles, and its tributaries, large and small, number fully 12,000.

The Thames, although not the largest of British rivers, is, undoubtedly, the most important in many aspects beside commercial; it takes its origin from some rather insignificant brooks and rivulets near Cirencester; at Thames Head Bridge its level is 376 feet above that of the sea; its direct course to the Nore is 124 miles, and the area of its basin is 6,160 square miles. What is, however, of far more importance in this comparison of these rivers for our purpose, is the fact that, throughout its entire course, and especially previous to the point of bifurcation, the waters of the Rhine essentially retain that purity which gave rise to its being named in Switzerland, "*Reiner*" (purity). Dr. Von Planta Reichenau, an eminent Swiss *savant*, and the owner of large estates on and near the sources of the Rhine, has analysed its waters, taken at different seasons of the year and at different places of the course of this river, from Reichenau downwards to Emmerich, and has found that, what is in a very high degree the case with these waters at their primitive source, is retained in a very marked measure over this entire length of the river's course, viz., that the water always contains, dissolved, a large and abundant quantity of oxygen: this, coupled with the fact that the large bulk of the water of this river is not, to any great extent, modified by the water of its tributaries, some of which are large streams also taking their origin in ice and snow, may have some bearing upon the very small quantity of organic matter and the infinitesimal small quantity of ammonia met with in the water of the Rhine.

Sufficient has been said to point out that there exists a primitive and essential difference between the sources of the supply of water of the Thames and Rhine to account for more impurity in the latter, while, moreover, the value of manure of all kinds is too greatly esteemed along the major portion of the course of the Rhine to allow fæcal matters and other refuse and offal to find its way into a river, the police of which, or, rather, *administration de la sureté publique*, about which is under the control, not of one state, but of that of France, Baden, Bavaria, Hesse-Darmstadt, Prussia, and the Netherlands, jointly, whereby proper care is also taken as regards the fouling of the river and the pollution of its waters. Except in the Netherlands, and excepting also the men who, while navigating the Rhine or its tributaries, drink of its waters, that water is not used for drinking purposes by the great bulk of the large population dwelling on the banks of that river, since excellent water of easier access than that of the river is readily to be had. The writer of this article had, last year, while in Germany, an opportunity of obtaining some information about the supply of water, quantity, and quality, in use by the large numbers of soldiers at Coblentz, Cologne, Wiesbaden, and other places; great care has been taken to insure a constantly plentiful supply, and, above all, of good quality, by boring deep wells. Notwithstanding, the river water is excellent to the taste, rather less saline, however, and is certainly better for washing purposes, neither the military nor civil population of the places just named, and others situated along the Rhine, Moselle, Lahn, Maine, &c., ever think of using the water of these rivers, which, in many instances, indeed, they would have to fetch at a comparatively great distance from their dwellings. The writer was also informed that the water obtained from the public pumps, pants, and fountains, was regularly submitted to analysis, and that the authorities took great care to keep wells, and tubing, and all works in proper repair, so as to insure good and wholesome water.

Turning now to our chief subject, we quote, in the first place, the results of analysis, and other particulars of the water of a canal at Zwolle. This canal is so connected with the Züyder Zee and tidal rivers that its level, by the effect of the flood and ebb, varies about 13 inches daily; the water was clear, pale yellow coloured, its taste somewhat similar to rain-water; on standing, it deposited a sediment, which, on being submitted to microscopic research, proved to contain not only minutely divided mineral matter, but also various infusoria, remnants of partially peatised vegetables, and small molluscs.

The result of the chemical analysis in this, as in every following instance, refers to *one* litre of the water, and the quantities are expressed in grammes—Total solid residue, 0·181; organic matter, 0·020; sulphate of lime, 0·0087; carbonate of lime, 0·0008; alkalies, 0·066, consisting chiefly of chlorides without any sulphates; ammonia, 0·00023; nitrates or nitrites, none; colour of dry residue, yellow before ignition, grey after. This water is not liked for drinking or domestic purposes, but occasionally used.

Water from a Pump at Groningen.—The well supplying this water is in very permeable soil; from the surface to a depth of 2·7 metres, layers of peaty soil are found; next follow sand and gravel. At 3·5 metres distance from the pump, an open sewer—a dirty ditch—runs. The water of the well is undoubtedly partly surface-water. Its physical properties are—Dark yellow colour; somewhat milky turbidity; taste not disagreeable, but very vapid. The microscopical examination of the sediment led to no other result than that structureless membranes were seen, which

disappeared when a single drop of dilute hydrochloric acid was added, causing, at the same time, effervescence. Analysis yielded the following results:—Total solid residue, 1·386; organic matter, 0·225; sulphate of lime, 0·1094; carbonate of lime, 0·6556; alkalies, 0·396, consisting chiefly of chlorides without any sulphates; ammonia, 0·00700: nitrates or nitrites, none; colour of dry residue before ignition, brown; after, black. Almost all who reside in the neighbourhood where this pump is placed detest the water: it is only used after having been left quietly standing for at least twenty-four hours, and then only after having been boiled and cooled again. At the time the water was taken for analysis, much rain had fallen. The city of Groningen is situated at a considerable height above sea-level, as compared with many other places of the kingdom.

Water taken from a Brook situated near Leeuwarden, in the Alluvial Soil of the Sea formerly existing there.—The bottom of this brook consists, for about 2 metres depth, of a layer of partly-decayed fresh-water plants. At about 150 metres distance from the brook, a large dung-heap is permanently placed. Physical properties of this water—Nearly colourless; quite limpid; tastes like rain-water. After long standing, a very slight sediment is deposited, which, on microscopic investigation, was found to consist of very small molecules, and flocculent vegetable matter, containing the very lowest order of infusoria. Result of chemical analysis—Total solid residue, 0·5135 gramme per litre; organic matter, 0·0675; sulphate of lime, 0·0583; carbonate of lime, 0·2617; alkalies, 0·126, chiefly chlorides without any sulphates; no ammonia, and only very faint traces of nitrates; colour of residue before ignition, yellow; after, greyish black. This water is largely used by the inhabitants, and very well liked. At the time the water was taken for analysis, not much rain had fallen. The level of the water in this brook is 47 centimetres below A. P.,* which is about sea-level.

Water from a Pump at Dokkum.—This pump is placed on a now disused cemetery. The water is collected in an underground vault made of masonry. The level of the water is 2·45 metres below the surface of the pavement, and is evidently also fed by a canal which is situated at about 100 metres distance from the vault. No sewers are anywhere in the neighbourhood; but close to the pump is a building used as a school-house, and this place being unprovided with an urinal, the boys (200 in number) are in the habit of making their water outside the school, against the wall, in consequence whereof the soil in the immediate vicinity of the pump is saturated with urine. The water is about colourless, clear, and limpid, and not at all disagreeable to the taste. A sediment subsides after some time; and this, on being investigated with the microscope, was found to contain molecules of clay, very small vegetable seeds, and pieces of threads of white wool and blue cotton. Total solid residue, 1·6935; organic matter, 0·1550; sulphate of lime, 0·4669; carbonate of lime, 0·2831; alkalies, 0·7885, chiefly chlorides without any sulphates; no ammonia; no nitrates or nitrites; residue yellow before ignition, grey after. This water is not much used, except by the schoolboys. At the time the sample was taken for analysis, there had been a good deal of rainfall.

Water from a Canal called the Dedemsvaart, Province of Overijssel.—This water is derived from the extensive peat bogs, to which the canal gives ready access. Its colour is as dark as sherry, but it is limpid and clear; taste vapid and disagreeable. The sediment which subsides exhibits, when viewed under the microscope, a multitude of peatified vegetable substances and infusoria. Total solid residue, 0·131; organic matter, 0·080; sulphate of lime, 0·0146; carbonate of lime, 0·02854; alkalies, 0·021; no sulphates; ammonia, 0·00041; of nitrates rather a large quantity; residue brown, black after ignition. While burning, it gives off an odour resembling that of smouldering nitrogenised organic matter. No rain had fallen for several days when the sample of water for analysis was taken. This water is not used for drinking or domestic purposes.

Water from a Pump surnamed the "Staten Pomp," at the Hague.—This pump is placed close to one of the most ancient buildings in the said town, and stands on a comparatively high level. The level of the water in the well is about 3 metres below the pavement. A thin brick wall only separates this pump and well from an extremely foul and dirty canal, a rather large open sewer, which winds its course to a large canal named the "Spui." The water is rather turbid; does not become clear on standing; exhibits a yellowish colour; taste saline; no microscopic investigation. Total solid residue, 0·750; organic matter, 0·060; sulphate of lime, 0·0639; carbonate of lime, 0·1831; alkalies, 0·443; no sulphates of alkalies; ammonia, 0·01181; large quantity of nitrates; colour of residue before ignition yellow, after ignition grey. This water is largely used, and relished, by those who reside near enough to make it worth their while to fetch it.

Water from a Pump situated in the Cité Ouvrière belonging to M. Régout, at Maestricht.—This pump is of comparatively recent construction, is in good working order, and the well is built in by means of brickwork laid in strong hydraulic cement; a canal is at 159 metres distance. No infiltration of surface water, nor of the contents of a large underground sewage cistern, has been found to exist. The water is of excellent quality, quite clear, colourless, and pleasant to the taste. Total solid residue, 0·650; organic matter, 0·020; sulphate of lime, 0·043; carbonate of lime, 0·342; alkalies, chiefly as chlorides, 0·245; no sulphates of alkalies; no ammonia; no nitrates nor nitrites. The soil in and about Maestricht is full of fossils, and noted for having been the place where very interesting animal remains have been found, while, moreover, the town, in consequence of having been since at least three centuries a fortress, and having frequently been besieged for months together, is, in a sense, a vast cemetery, full of the human remains of soldiers killed during such sieges and interred within the town, which, however, is of large extent of surface. Colour of solid residue of water before ignition, pale brown; after ignition, greyish black. The water is largely used, and very much praised and relished.

Rain-water Collected at St. Annaland, Province of Zeeland, at no great distance from the Sea.—The water was taken from a large, well-made, underground cistern, used for storing the water, built of bricks and strong cement; the water, on falling on a tiled roof, is led by means of wooden spouts to the cistern, which is surrounded by sand and clay soil; the water was slightly coloured, somewhat turbid, but does not deposit a sediment; taste, the same as is usually experienced from rain-water. Total solid residue, 0·4775; organic matter, 0·055; sulphate of lime, 0·136; alkaline chlorides, 0·2085; alkaline sulphates, 0·004; no ammonia; a very faint trace only of nitrates; colour of residue, before ignition, pale yellow; after ignition, pale grey. The water is much used, since there is no other but brackish water, quite unfit for any use.

Water taken in the Middle of the River Merwede (a local name given to a portion of the Rhine after the river Maas has joined it near Woudrichem).—Off the town of Dordt, the river is at this point about 1200 metres wide, and rather deep. The water was taken about the middle of the month of March last year. The water was very turbid, did not become clear on standing, and its taste was disagreeable. Total solid residue, 0·160; organic matter, 0·040; sulphate of lime, 0·0355; carbonate of lime, 0·420; alkalies, chiefly chlorides, 0·0425; sulphates of alkalies, none; ammonia, none; of nitrates, a faint trace; colour of solid residue, before ignition, pale yellow; after, pale greyish. This water is largely used, but in many households it is filtered previously.

* A. P. stands for *Amsterdamsch Peil*, which is the starting point, or zero, from which all levels below or above are measured in Holland. This true and very accurately-determined point was first adopted at Amsterdam about the year 1680; and, after having been verified over and over again, has been, since 1818, adopted as the general zero of all levels in the country.

Water from a Well bored, in 1866, at the Hague, for the private use of a Manufactory.—Total depth of boring, 5·65 metres, passing through 1·05 metre of sand; 0·40 metre of blackish peaty soil; 1·0 metre pure peat bog; 0·70 metre sand and peaty veins; 1·50 metre bluish coloured sand; 1 metre white-coloured sand mixed with shells of molluscs; the water leaves 0·704 gramme to the litre of solid residue dried at 120° C.; organic matter, 0·198; carbonates of lime and magnesia, 0·192; chloride of sodium, 0·247; sulphuric acid, 0·006 gramme to the litre; no ammonia, and no nitrates nor nitrites have been detected in this water although diligently sought for in a large quantity of water carefully evaporated to small bulk; the water is not colourless, but excellent to the taste, and the supply very abundant.

Results of the Analysis of Three Varieties of Water, obtained at Rotterdam by means of Norton's Well Tube, driven into a Layer of Whitish coloured Sand.—No. 1 well is 23 metres deep below sea level; No. 2 well has the same depth; No. 3 is about 14 metres below sea level. The physical qualities of these waters are good; the water has risen within the tube to about 1 metre below the surface of the mouth of the tube, which is level with the soil wherein it is driven.

	I.	II.	III.
Total solid residue ..	0·708	0·320	0·448
Organic matter	0·146	0·094	0·094
Carbonates of lime and magnesia	0·204	0·068	0·170
Chloride of sodium ..	0·098	0·029	0·093
Sulphates, calculated as SO_4	—	0·004	—
Ammonia	0·021	0·020	0·011
Nitrates	Decided reaction.	Decided reaction.	Very strong reaction.

The analyses of the few samples of water selected for quotation from upwards of 300 analyses published in the report, represent the varieties of water used for domestic purposes in the Netherlands; to wit, rain-water, river-water, water from brooks and canals, water taken from more or less deep wells, sunk or bored, into the ground to more or less depth, but never reaching to layers of very solid, and never to what should be properly called rocky, material. The localities selected are situated many miles distant from each other. As regards the alkalies, potassa and soda, it should be observed, that while generally no sulphates of the same are met with, a portion of these substances is very frequently combined in the waters analysed with humic, ulmic, crenic, and apocrenic acids and other organic substances. The composition of the water of the great rivers, passing through the country, does not materially differ at any point of their course as long as that water remains potable, from not being within sea reach, when the samples are taken at the same period of the year.

SPECTROSCOPIC OBSERVATIONS OF THE SUN.*

By Lieut. J. HERSCHEL.

THIS letter, written from Bangalore, states that the author discovered a new line in the spectrum of the sun's rays, in the neighbourhood of G; the author determined its position without difficulty, with reference to the rest of that crowded group of solar lines, and found it identical with the thick line at 2796 of Kirchhoff's chart; while studying this newly-discovered line, the writer succeeded in distinctly seeing a fainter red flash, already described by Mr. Lockyer, and he also noticed another line (the 6th) between F and G. These lines are defined by the figures of the Greek alphabet, and their number and position indicated according to Kirchhoff's chart. The letter then enters into details of mode of observation, and proceeds to discuss an article by Mr. Huggins in the *Quarterly Journal of Science*. This part of the letter, however, is not suitable for abstraction.

* Abstract of a letter addressed by the Author to W. Huggins, F.R.S., and communicated by him to the Royal Society.

NOTICES OF BOOKS.

Laboratory Teaching; or Progressive Exercises in Practical Chemistry. By C. L. BLOXAM. John Churchill and Sons. 1869.

WE can scarcely imagine a man more competent to treat of laboratory teaching than Mr. Bloxam. Commencing his studies at the College of Chemistry, he soon became the first assistant there, and the work which he then brought out in conjunction with Mr. Abel has long been familiar to the student of practical chemistry; altogether, for no less than twenty-three years has Mr. Bloxam been a teacher of laboratory practice; hence we have before us no imaginative system, elaborated in the mind but unpractised in the laboratory, but a system of instruction based on—nay, entirely made up of—experience. And it is not alone the most efficacious mode of teaching practical chemistry which must result from lengthy experience, but an exact and elegant manipulative skill; and an ingenuity in devising processes and experiments are alone attainable by this means.

The work before us is quite devoid of any theory; there is not a formula or a symbol in the whole book; it is essentially a treatise on *practical* chemistry. It contains, in the words of the author—

(1). "A series of simple tables for the analysis of unknown substances of all kinds (not excepting organic bodies) which are known to be single substances, and not mixtures.

(2). "A brief description of all the practically important single substances likely to be met with in ordinary analysis, by which the learner may satisfy himself that his results are correct, and may, at the same time, become acquainted with the leading properties of the most important chemicals, and with the foreign substances which they are liable to contain.

(3). "Simple directions and illustrations relating to chemical manipulation, not collected into a separate chapter, but given just where the learner requires them in the course of analysis.

(4). "A system of tables for the detection of unknown substances with the aid of the blowpipe.

(5). "Short instructions upon the purchase and preparation of the tests, intended for those who have not access to a laboratory."

Mr. Bloxam describes the various processes of chemical manipulation with an extreme minuteness of detail, and always effects his object by the simplest means; thus he says, "When a mortar is not at hand, substances of moderate hardness may be powdered on a hard surface by rolling a bottle over them;" a piece of broken porcelain may be often substituted for platinum foil; and Bunsen's burners may be improvised by placing a funnel over and a little distance above an ordinary gas-burner. We think, however, that a crudity of operation, although safe in the hands of a careful and accomplished chemist like Mr. Bloxam, may lead to carelessness and a want of delicacy and cleanliness in the student; it may lead him to regard processes which require the utmost skill as more or less rough operations, in which a large margin may be left for error of action. To our mind, we cannot have too elaborate or perfect apparatus for our infinitely delicate chemica

operations; we cannot warn the student too often against inattention to minute points of cleanliness in his operations; we cannot too often impress upon him the necessity of rendering assurance doubly sure—the double rinsing of his cleaned (and nominally clean) test-tubes, and other vessels, the examination of the purity of his tests, the infinite solicitude which he must give to his boiling liquid, or his filtering solution, lest one small drop—be it but so much as makes "the twentieth part of one poor scruple"—be lost; and, although in qualitative analysis the need for extreme caution is to some extent removed, we must remember that a careless habit once acquired is not relinquished when the student passes to quantitative analysis. We were in a laboratory the other day which, for neatness and cleanliness, not to say primness, might vie with a quaker's drawing-room; not a speck of dust was visible, not a bottle had dirty streaks of its contents coursing down its sides to deposit themselves on the shelf beneath; there was no confusion, and the air was as fresh as it ever can be in London; the usual dirty benches were replaced by clean slabs of plate-glass, whitened beneath, and everything was trim and smart. Yet this was not one of the laboratories of the *dilettanti*; there was plenty of good hard work going on in it; and, with a little management, all laboratories might be equally clean.

Mr. Bloxam has introduced a number of extremely useful tables into his work, to indicate the mode of detecting various elements and compounds; these tables are explained in the text, and constant back-reference is given to them and to individual paragraphs, which latter are distinguished by thick-letter numbers. Not only do we find the modes of detecting the simpler substances, but a large number of organic bodies are also introduced, together with the means of their identification; thus we find picric acid, cholesterine, acetone, naphthaline, aniline, and many other organic bodies described. Altogether, the work is most comprehensive; a great deal could be done with it; a chemist cast upon a desert island with it, and a box of reagents, could examine with ease all the principal products of the place, both mineral and vegetable. To the mining chemist, the work will be of much service; indeed, its usefulness is by no means confined to the student: we venture to assert that the book will be found useful in every laboratory as a work of quick reference and concise direction.

Mr. Bloxam is a thorough conservative; we imagine he is the General Peel of his party—a thoroughly conscientious, sound, true old tory, just a thought obstinate, but with the firmest convictions. It will be remembered that, in his "Chemistry Inorganic and Organic," he has not adopted the new nomenclature or the new equivalents; and we observe here that he has introduced such words as "white vitriol," zinc-white," "Glauber's salt," and "Scheele's green." An air of conservatism pervades the whole work, yet we do not intend to deprecate this, but are rather of opinion that it may help to check the rapidly-advancing tide of chemical radicalism.

MISCELLANEOUS.

Alkaloid Formed during Alcoholic Fermentation.—M. Oser has instituted researches with pure sugar brought into fermentation, and, after a series of operations, has succeeded in obtaining an alkaloid composed according to the following formula:—$C_{18}H_{20}N_4$. The hydrochloric acid combination has the formula—$C_{18}H_{20}N_4HCl$; the combination with chloride of gold is expressed by $C_{18}H_{20}N_4AuCl_4$. The author states that this alkaloid is positively the result of fermentation; but he also intimates that, since older wines contain, according to Ludwig's researches, trimethylamine, it is probable that the alkaloid here alluded to is either decomposed in older wines, or is only met with therein in very minute quantities.—*Polyt. Centr.*

Estimation of the Goodness of Soap.—Prof. Schültze, of Rostock, starting from the view that, the better the soap, the less thereof will be required for the entire unhardening of water, employs the reverse of Clark's process, in the following manner:—He applies a solution of lime in water containing excess of carbonic acid, so that litre of water contains exactly 1·6 grm. of lime. Of this fluid he takes 3 c.c. (containing, accordingly, 4·8 milligrms. of lime), and adds 20 c.c. of water, and a small quantity of soda solution; he further applies an aqueous solution of 5 grms. of soft soap in 100 c.c., or of the same quantity of solid soap in 200 c.c., of water, and adds of these solutions from a burette to the aforesaid lime solution until a lather is fully and completely formed. The smaller the quantity of soap solution required for this purpose, the better, of course, the soap is; and it is easy to calculate how much of the soap solution has been required for one part, by weight, of lime; a perfectly pure soap, however, will be required, for comparison's sake.

Nitroglycerine.—The only safe and proper mode of permitting the use of this substance is, undoubtedly, that adopted in France, Southern Germany, Belgium, and the United States, that is, to allow its use only on the absolute condition that it be made on the very spot where it is wanted, and be only made in quantities sufficient for, at most, three days' sufficient supply. In an article which appeared in the CHEMICAL NEWS, No. 422, vol. xvii., p. 11 (January 3, 1868), on this subject this point was briefly alluded to; and the experience since obtained in the countries above-named, the United States being foremost in this matter, has fully proved the utility of this rule. Nitroglycerine making is readily taught to workmen, and, with some care, succeeds exceedingly well. There is no sound reason why this plan should not be adopted in this country too.

Hygrometer.—Naudet and Co., Paris, Rue et Place Thorigny, 2 and 4, have constructed a portable hygrometer, shaped like a watch. The measuring of degree of moisture is effected by means of a peculiarly-prepared human hair, 0·35 metres long. The mechanism is graduated by placing the instrument under a bell-jar, wherein the air is kept dry by means of recently burnt quick-lime and fused chloride of calcium; and next it is placed under a bell-jar, wherein the air is kept saturated with moisture by means of a wet sponge. The distance between these two extremes, indicated by a properly-constructed mechanism, is divided into 100 parts. The price of this instrument, which is highly spoken of, is 25 francs (£1). It is intended for use in spinning and other establishments, and for observations. —*Deutsche Ind. Zeitung.*

Indelible Ink.—Two solutions are required—No. 1 consisting of—Crystallised chloride of copper, 8·52 parts; chlorate of soda, 10·65 parts; and chloride of ammonium (sal ammoniac), 5·35 parts, to be together dissolved in 60 parts of distilled water. No. 2 solution consisting of 20 parts of hydrochlorate of aniline, to be dissolved in 30 parts of water, to which has to be added 20 parts of a solution of gum (made by dissolving one part, by weight, of gum in two parts of water), and, lastly, 10 parts of glycerine. These solutions are kept in separate bottles. When it is required to write anything with these fluids, one part, by bulk, of solution No. 1 is mixed with four parts, by bulk, of No. 2. The ink must be applied to paper, linen, cotton, wool, or silk, with a quill pen, or small hair brush; at first the writing appears greenish, but it soon becomes black, especially if it is exposed to a higher temperature. This writing is perfectly indelible, and can only be destroyed by destroying the fabric it is placed on.—*Dr. Artus's Vierteljahreschrift.*

Production of Oxygen for Industrial Uses.—The works, in running order, although not yet quite finished, are located at the foot of Forty-first Street, in this (New York) city, a malodorous neighbourhood, where some means, artificial or otherwise, would not be out of place in substituting oxygen for the foul emanations of butchers' shops and dirty gutters. The essential or characteristic portions of the process are carried on by the aid of brick furnaces, of which only one was in operation at the time of our visit, several others being, however, rapidly put up and fitted for use. Each furnace has its fire-box so arranged as not only to heat the retort which holds the manganate of soda (the vehicle through which the process is carried on), but also one or more chambers through which an air-blast passes to the retort. The retort, furthermore, communicates, by a pipe furnished with stop-cocks, with a suitable steam-boiler. The process is carried on as follows:—About 600 pounds of manganate of soda are placed in the retort, heated to the requisite degree in the furnace; superheated steam from the boiler is then admitted for about ten minutes. Two equivalents of the manganate of soda and two of water react upon each other, as indicated by the formula—

$$2(MnO_3,NaO)+2(HO)=2(NaO,HO)+Mn_2O_3+O_2.$$

In other words, the water combines with the soda of the manganate to form a hydrate of soda. The manganic acid is changed to sesquioxide of manganese, containing only half the proportion of oxygen, and the other half of the latter passes off in a free condition. At the conclusion of this part of the process, the steam is shut off, and the superheated air is admitted for about fifteen minutes, whereupon the sesquioxide combines with more oxygen from the air, and is converted back into its original form of manganic acid, which, of course, resumes its former relation to the soda, reconstituting manganate of soda, ready for a repetition of the process. In forcing the air to the apparatus, a steam-pumping engine is used, noticeable for the manner in which friction gearing is applied to transmit power from the engine to the air-forcing pumps, without the jar incident to the use of cogged wheels. The air-blast passes first through cylindrical vessels containing caustic soda, by which its carbonic acid is removed, and thence through the superheating chamber previously mentioned, to the retort. The retort is never opened, as the material shows no signs of deterioration by use. That in the retort at the time of our visit was tested continuously for six months before being brought to this country, and has been in constant use for six weeks past, the period during which the works have been in constant operation. As the oxygen leaves the retort it passes through a suitable meter, which registers the quantity, and thence to the gasometer, which, at the present time, contains 25,000 feet of oxygen gas, much purer than is required for most of the purposes for which it is to be employed.—*American Artisan.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, March, 1869.

This number of this periodical, which is always rather behind-hand as regards its time of being published, does not contain any memoirs or papers which bear upon chemistry, or sciences closely allied thereto.

Annales des Mines, vol. xv., 1st part for 1869.

This periodical contains—

A Biography of the Chemist, P. Berthier.—A concise review of his arduously-accomplished and incessant labours. This lengthy paper is concluded by an enumeration of the titles of the memoirs, papers, and books published by this *savant*, which catalogue occupies no less than fourteen octavo pages, printed in small type.

Although not belonging to the subjects usually treated by us, we cannot refrain from calling attention here to an excellent report on a steam boiler explosion, which took place at Moulins-Lille.

The rest of the papers in this number of this periodical bear upon practical mining, and are not of general importance.

Revue Universelle des Mines, de la Métallurgie, des Travaux Publics des Sciences et des Arts Appliqués a l'Industrie, Nos. 1 and 2 for 1869.

This very useful periodical is published in Belgium, and its editors are Belgians of high scientific as well as practical attainments. The first paper we meet with in this number is an excellent monograph on the—

Mineralogical Character and the Mineral Value of the Iron Ores of the Province of Luijk (Liege).—M. Franquoy.—From among the large number of analyses which accompany this very lengthy paper, we quote the analysis of a couple of samples of *fer-carbonaté lithoide des houillères*. The first sample contains, in 100 parts:—Carbonate of iron, 73·66; carbonate of lime, 2·98; carbonate of magnesia, 2·06; carbonate of manganese, 3·31; clay, 12·17; water and carbonaceous matter, 5·53; phosphoric acid, 0·29; yield of metallic iron, 34·76 per cent; specific gravity of this sample of ore, 3·15. The other sample contains, in 100 parts:—Carbonate of iron, 56·23; carbonate of lime, 4·84; carbonate of magnesia, 2·93; carbonate of manganese, 0·58; clay, 26·20; water and carbonaceous matter, 9·22; phosphoric acid, a trace; yield of metallic iron, 26·96 per cent; specific gravity of this sample of the mineral, 3·123.

On Saccharimetry.—This paper is a magnificent monograph on this subject, being the result of researches instituted in consequence of the International Convention agreed to by France, the United Kingdom, the Netherlands, and Belgium, on the 8th of November, 1864, in reference to the rules which shall apply to the amount, and mode of payment, of the duties on sugar in these four countries. The paper here alluded to is chiefly the work of Prof. Landolt, of Bonn, and is published by the kind permission of His Excellency the Belgian Minister of Commerce; we regret that it is too full of interesting matter, too concisely written, and, moreover, by far too lengthy for any useful abstraction. As a curiosity rather, and as proving the correctness of the figures adopted by the Netherlands Society of Commerce—whereby raw sugars are designated by the cypher-figures 1, 2, 3, and so on up to 21, according to the degree of purity, and the higher percentage of crystallisable sugar contained in the various samples so designated—we quote the following analysis:—No. 9, in 100 parts—Pure cane sugar, 89·6; organic salts, 4·3; water, 3·8; undetermined substances, 2·3. No. 12, in 100 parts—Pure cane sugar, 93·0; organic salts, 3·7; water, 3·1; undetermined substances, 0·2. No. 15, in 100 parts—Pure cane sugar, 95·0; organic salts, 1·6; water, 2·0; undetermined substances, 1·4. The composition of treacle, in 100 parts, varies between the following limits:—Best sample contained—Cane sugar, 61·8; sucrose (*sucre interverti*), 1·9; salts, 18·9; water, 14·2; undetermined substances, 3·2. Worst sample contained—Cane sugar, 54·4; sucrose, 1·6; salts, 19·9; water, 21·0; undetermined substances, 3·1. All the experiments were made on samples taken from quantities several thousand kilogrammes in weight, and they were performed at Cologne, in the establishment of the Rheinischen Actions Verein für Zuckerfabrikation, one of the largest and best-conducted sugar refineries in the world.

Observations on M. Margueritte's Process of the Volumetrical Estimation of Iron.—M. Léon Moyaux.—This paper ends with the following concisely-stated conclusions, arrived at by the author as result of his experiments:—1st. The normalisation of the permanganate solution can only be properly made by means of metallic iron, and, when the latter metal, in sufficiently pure state for this purpose, does not happen to be at hand, by means of oxalic acid (indirect titration). 2nd. The use of ammonio-sulphate of iron should be rejected; unless, indeed, the precise composition of this salt is repeatedly ascertained, it is not to be relied on, and this testing is a loss of time. 3rd. Repeatedly-continued research is required to ascertain that the solutions of *proto*-salts of iron really keep and continue to be so. 4th. The evaporation of solutions of iron containing hydrochloric or other volatile acids, after the addition of sulphuric acid, always impairs the result of the titration. 5th. The reduction of solutions of *per*-salts of iron to *proto*-salts, after driving off excess of hydrochloric acid, is best effected by means of zinc, better yet by means of amalgamated zinc; but this last metal is to be rejected when a solution of iron happens to contain, at the same time, a proto- and a per-salt. 6th. When 0·3 grm. of ore is taken for assay, in case the ore should contain more than 40 per cent of metallic iron (or, when less than that quantity, 0·5 grm. is taken for assay), the quantity of fluid best suited to yield accurate results should not, in either of these cases, respectively exceed ½ or ¼ a litre.

The other papers of this periodical relate chiefly to mechanical engineering and machinery.

Chemisches Centralblatt, No. 21, May 26, 1869.

The larger part of this paper is occupied with a treatise on the—

Chemical Constitution of the Organic Hydrocarbons.—M. Kolbe.—The author of this lengthy treatise begins by stating that, however ingenious M. Kékulé's theory may be, that theory is, after all, a failure, and in every respect erroneous. The author next states that, according to his opinion, a solid basis for speculation, on the true constitution of the organic hydrocarbons, is to be deducted from our experience with organic ammonias. The comparison of these two kinds of compounds has made clearly understood to him the nature of di- and tri-carbon acids, in reference to mono-carbon acids; and the organic ammonias, wherein nitrogen and phosphorus equivalently act, are the counterpart and example for the mode of constitution of the carbo-sulpho-acids. Ammonia, H_3N, and marsh gas, H_4C, are, in this sense, comparable, and may be placed side by side, just as, from ammonia, by substitution of the hydrogen atoms for the alcoholic radicals, organic ammonias are produced, which possess basic properties, so, from marsh gas, *carboles* are formed. Ammonia, therefore, agrees (*entspricht*) with the carbol, H_4C; the methylamine, the methyl-carbol, and di- and tri-methylamine agree with the di- and tri-methyl-carbol.

$\left.\begin{matrix}H\\H\\H\end{matrix}\right\}N$	$\left.\begin{matrix}CH_3\\H\\H\end{matrix}\right\}N$	$\left.\begin{matrix}CH_3\\CH_3\\H\end{matrix}\right\}N$	$\left.\begin{matrix}CH_3\\CH_3\\CH_3\end{matrix}\right\}N$
Ammonia.	Methylamine.	Dimethylamine.	Trimethylamine.
$\left.\begin{matrix}H\\H\\H\\H\end{matrix}\right\}C$	$\left.\begin{matrix}CH_3\\H\\H\\H\end{matrix}\right\}C$	$\left.\begin{matrix}CH_3\\CH_3\\H\\H\end{matrix}\right\}C$	$\left.\begin{matrix}CH_3\\CH_3\\CH_3\\H\end{matrix}\right\}C$
Carbol.	Methylcarbol.	Dimethylcarbol.	Trimethylcarbol.

The learned author proceeds, in this manner, with his essay, proving, by a great variety of instances, the truth of his statement; his paper is, however, not well suited for abstraction, and the less so from the fact that, in the above-named periodical, a condensed abstract only is published.

Reduction of Carbonic Acid to Oxalic Acid.—M. E. Drechsel.—Pure and clean sodium, exhibiting a metallic surface, is placed, along with some freshly-ignited quartz-sand, into a clean flask, and a rapid stream of carbonic acid gas is passed into the flask, which, at the same time, should be heated to the temperature of boiling mercury, 662° F. The sodium molten at this temperature yields, on being stirred up with a glass rod, a silvery semi-fluid paste. As soon as the reaction sets in, the metal assumes a purple colour, and, after a few hours, is converted into a dark pulverulent mass. Too much heat should not be applied; and, especially towards the end of the operation, great care is required in managing it, since a too high degree of temperature may cause the combustion of the newly-formed product. After having cooled in the flask, the substances therein contained are withdrawn from it, and, having been spread out in a thin layer, so as to effect the oxidation of any small particle of sodium not yet acted upon, the mass is exhausted with water, the aqueous solution saturated with an excess of acetic acid, and, after having been filtered, precipitated with chloride of calcium; the precipitate thus formed is almost always rather brownish coloured. It is dissolved in hydrochloric acid, filtered while yet hot, and precipitated with ammonia, whereby the salt, oxalate of lime, is obtained perfectly snow-white; 60 grms. of sodium yield, by this process, 6 grms. of pure oxalate of lime. Instead of sodium, a potassium-amalgam, containing 2 per cent of the alkali metal, and otherwise treated in the manner just described, yields a fair percentage of oxalate of potassa.

Nos. 22 and 23, June 2 and 9, 1869.

These two numbers do not contain any original memoirs, papers, or communications.

Bulletin de l'Academie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 4, 1869.

The only treatise contained in this number relating to chemistry is the first portion of an essay on the—

Isomerism of the Salicylic Series.—M. L. Henry.—The first section is headed—*Chlorinated Derivatives from Salicylic Aldehyde.* The derivatives of the *mono-substitués* of toluen and benzoic acid are pretty well known, and ought, according to this author, to be separated into three distinct groups, designated respectively—*ortho, para*, and *meta* series, each of these embracing a peculiarly characteristic monochlorinated benzoic acid, $C_7H_5ClO_2$, and a diatomic acid $C_7H_6O_3$. The author also proposes to name each of the three groups already alluded to the *ortho*, or *oxy*, the *para*, or *oxybenzoic*, and the *meta*, or *salicylic* series. Of each of these series a large number of very complex formulæ are given by the paper, however interesting in a purely scientific point of view, is, on account of its length, and on account of the large space which the quotation of the formulæ would require, not quite suitable for further abstraction.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 9, May 23, 1869.

We notice the following original papers from this periodical:—

Contribution to our Knowledge of the Doubly-Coupled (Gepaarte) Compounds of Inorganic Chemistry.—M. C. W. Blomstrand.—In the introduction to this paper, the author refers to a published work of his, to which the title "Die Chemie der Jetztzeit" (the chemistry of the present day) is given. Next, he states that, when explaining and settling the question about coupling, he mentioned some experiments of his on the behaviour of iodine towards yellow prussiate of potassa, which were not quite successful. The author next proceeds to review the ammonia compounds of platinum, and says that he considers the so-called platino-cyanide of chloride of potassium, $2KCl + PtCy_2$, to be the perfect analogue of Grosses's base, which manner of viewing may be made evident by giving to the respective formulæ of these substances the following form:—Grosses's base—

$$(Cl—NH_3—NH_3)_2Pt_1Cl_4;$$

platino-cyanide of chloride of potassium—

$$(K—Cy—Cy)_2Pt_4Cl_4.$$

The author next proceeds to describe a lengthy series of researches on this subject, but his paper, an abstract of an abstract and *viva voce* communication by Dr. H. L. Buff, at the meeting of the Society, is too full of formulæ to be suitable for further abstraction.

On Binitro-Cresol.—MM. Martius and Wichelhaus.—There is met with in commerce, under the name of Victoria yellow, or aniline orange, a reddish powder, which yields highly yellow-coloured solutions, and bears, in general, great likeness to the binitro-naphthol compounds. The authors have instituted some researches on this material, and have made found it to be a nearly pure binitro-cresol salt. The binitro-cresol they separated from it is readily soluble in alcohol, ether, chloroform, and boiling water; it may be obtained in crystalline shape; the dry substance fuses at about 110° C.; the silver-salt is rather difficultly soluble, and may be obtained in crystals. The authors have tried in vain to obtain, by the experimental method, a clue to the mode of manufacture and origin of this material. The solutions of binitro-cresol become gradually deep-red coloured on exposure to air, and also when chloride of iron is added to the same.

Some Derivatives from Phenylacetic Acid (α Toluylic Acid. M. B. Radsiszewski.—The author first describes the method whereby he prepared this acid; we need not repeat this, as the author says it is well known, and is that used by Cannizzaro. The methyl ether of this acid is a colourless liquid of 1·044 sp. gr. at 16°; it boils at 220°, without decomposition. The ethyl ether of the above-named acid is a liquid, having a sp. gr. of 1·031; it boils at 226°. The author next proceeds to describe the action of bromine upon the α toluylic acid; then the action of bichromate of potassa and dilute sulphuric acid; next, the action of chlorine, of nitric acid, and other chemicals; and winds up with saying—"The result of my researches is, that the α toluyl acid behaves with the haloids, and with nitric acid, as does toluol, giving rise, chiefly, to the formation of para products."

On the Pyromucic Acid Group.—M. Limpricht.—This paper could not be understood without the reproduction of the woodcut annexed to it.

Action of Sulphuric Acid upon Polychlorated Hydrocarbons.—M. A. Oppenheim.—When ethylen-chloride is acted upon by sulphuric acid, at the ordinary temperature of the air, and at 100°, in sealed tubes, no action whatever ensues; at 130°, however, decomposition takes place, carbon is separated, sulphurous acid formed, and, hydrochloric acid generated. When chlorobenzol, $C_6H_5.CHCl_2$, is mixed, at the ordinary temperature, with sulphuric acid, hydrochloric acid is given off without causing a colouration of the liquid; but, at 100°, complete decomposition sets in, and carbonaceous matter is deposited. A syrupy product of this decomposition may be obtained, exhibiting a fluid having a constant boiling point at 175°; its smell is akin to that of the essential oil of bitter almonds.

Constitution of Epichlorhydrin.—M. L. Darmstädter.—The author states that, according to his opinion, the formula of epichlorhydrin has to be written—

$$O\begin{matrix}CH_2Cl\\CH\\CH_2\end{matrix}.$$

Next, he mentions some experiments, in order to prove that the oxygen of epichlorhydrin is combined, by double affinity, to carbon, and is not present therein as hydroxyl. To prove this, he states, at length, what action bromine and chloride of phosphorus exert upon substances containing hydroxyl; and then he gives an account of the action of these two chemicals upon epichlorhydrin. One of the results of this reaction is a liquid, which, in 100 parts, contains:—C, 15·22; H, 2·11; Cl, 15·01; Br, 67·65.

Constitution of the Native Combinations of Tantalum and Niobium.—M. C. Rammelsberg.—This paper is more of mineralogical than chemical interest; and, being an abstract from a large essay on this subject is not well suited for further condensation.

On Dinitronaphthalin.—M. A. de Aguiar. The author states that when dinitronaphthalin is prepared from naphthalin, an isomer thereof is formed at the same time which, being readily soluble in alcohol may by that means be separated from the not soluble variety. The variety soluble in alcohol the author calls α dinitronaphthalin; it is a crystaline solid substance, containing, in 100 parts: C, 55·04; H, 2·75; formula, $C_{10}H_6(NO_4)_2$. The solutions of this substance become red on exposure to the atmosphere, and also on being treated with ammonia; treated with nitric acid, trinitronaphthalin is formed.

Annalen der Physik und Chemie, von Poggendorff, No. 4, June 1, 1869.

This periodical contains, as usual, a large number of original essays, for, in reality, the labours of the authors are rather essays than papers. The first we meet with is—

A Contribution to our Knowledge about Thunderstorms.—M. W. Bezold.—Although this is a meteorological subject, we call attention to this paper, in compiling which the author has made use of the records of insurance companies in Bavaria and Austria, and also of some local statistics collected in the towns and districts, and has applied these materials for the purpose of making a valuable essay on a subject which, as he rightly remarks, cannot be so well elucidated by the observations made at the meteorological observatories, these being too few in number and too far distant from each other. Between the years 1844 and 1865, no less than 1143 buildings, among the large number of those insured against accidents by fire, in Bavaria, were struck by lightning; this is in the proportion of forty-four buildings struck by lightning each year, upon 1,000,000 of buildings insured. The essay, from which we cannot abstract more, on account of its subject matter being foreign to the subjects treated of in our paper, deserves the attention of those whom it may concern in many aspects.

On Leucitstone, as it occurs in a Peculiar Ore-Bearing Rock.—M. F. Zirkel.—This communication is a purely mineralogical essay, the subject of which is, beside, of local importance, only referring, as it does, to a single locality.

Certain Phenomenon of Refraction of Light first Observed by Quincke, and Changes of the Rays of Light during Total and Metallic Reflection.—M. E. Jochmann.—This, being an entirely mathematico-physical essay, is not suitable for abstraction.

Meteorites Deposited and Kept in Museums.—Dr. Buchner.—This is the fourth and concluding portion of a lengthy essay on this subject, compiled, in great measure, from previously-published papers dispersed through a series of periodicals.

A Hitherto-Unobserved Electric Powder Figure.—M. Kundt.—The author, referring to the well-known Lichtenberg figures, caused by electricity when very finely-powdered substances, such as Lycopodium, are applied to an isolator, states that he has discovered a new kind of these figures, formed on a conducting surface, and less dependent than the Lichtenberg figures upon the peculiar kind of electric developer to be used. The author describes, at length, the various means by which he obtained these figures.

Determination of the Specific Heat of a Constant Bulk of Air by means of the Metallic Barometer.—M. Kohlrausch.—A mathematico-physical essay.

Trigonal Pyramid ξ on the Quartz from Baveno.—Dr. Becker.—A mathematico-crystallographic essay.

Composition of Hydrofluocerite.—M. Nordenskjold.—The author says this mineral, which contains fluoride and cerium, was discovered in the year 1838, at the Bastnäs quarry, near Riddarhyttan, Sweden, and then analysed by M. Hissinger. The author further states that, when he resumed the researches of this mineral, he found that its earlier investigators had made a mistake as to its containing water, of which it contains a mere trace; and, next, he records the mode of his researches of the mineral now named by him *hamartite*, from the Greek ἁμαρτω, to err. The result of his analysis is, that this mineral contains, in 100 parts:—Oxide of lanthanum, 45·77; oxide of cerium, 28·49; carbonic acid, 19·50; water, 1·01; fluorine, 5·23. Formula, $CeFl + 2(LaO,CeO)CO_2$.

Grain Test for Bin-Axial Mica.—M. E. Reusch.—A crystallographical essay.

Discovery of Large Crystals of Quartz in a Very Difficultly-Accessible Portion of the Swiss Alps.—This paper is a reproduction from a newspaper published at Berne, and describes the cavern wherein these crystals were found; one of these weighs 267 lbs., is 69 centimetres in height, and has a circumference of 122 centimetres. This may suffice for this subject.

The editor of the *Annalen* very properly calls attention to a most useful work, now in regular course of publication under the auspices of the Prussian government—viz., the *Repertorium der Technischen, Mathematischen und Naturwissenschaftlichen Journal-Literatur*. This most useful work, to which we may add the index of foreign scientific periodicals, will, as justly observed by the editor of *Poggendorff's Annalen*, keep the place of a permanent and periodically-pub-

lished supplement to the catalogue of scientific papers published by the Royal Society. The repertorium records the titles of the papers of some 150 periodicals, in all languages, and published over the whole world. It may be inspected at the Library of the Commissioners of Patents, where it is regularly taken in.

Annalen der Chemie und Pharmacie, June, 1869.

Contents :—

Action of Boiling Liquids containing Acids and Alkalies upon Glass and Porcelain Vessels.—Dr. A. Emmerling.—This essay, or rather monograph, contains the record of a series of most minutely-executed experiments, whereby to determine the influence of various fluids, containing acids, salts, and alkalies, upon vessels made of different qualities of glass and porcelain, in order to determine the amount of substance dissolved by such chemicals, and also by pure distilled water, and to ascertain what influence is thus exercised upon the accuracy of analysis and chemical researches in general. This monograph is full of interesting details, including analyses of glass. *En résumé*, its leading features are the following:—The action of boiling liquids, as specified above, upon glass vessels is proportionate to the duration of time of boiling; the action is proportionate to the surface which is in contact with the boiling fluid; the action is independent of the quantity of fluid which evaporates during a given time; the action decreases with the decrease of temperature of the solution; alkalies, even in dilute solutions, attack glass very strongly; acids generally act less than pure water, excepting sulphuric acid; among the salts, those act most energetically whose acids produce insoluble salts with lime—*e.g.*, sulphate and phosphate of soda, carbonate of soda, and oxalate of ammonia, the action of each of which increases with the degree of concentration of the solution; such salts as form, in water, readily-soluble lime-salts—for instance, the chlorides of ammonium, potassium, calcium, and nitrate of potassa less strongly than pure water alone, and, with the greater degree of concentration of these salts, the action decreases. Bohemian glass stands acids better than the kinds of glass containing soda; the Berlin porcelain ware is only perceptibly acted upon by alkalies.

Researches on the Isomers of the Benzoic Series (ninth monograph, containing "The Chlorinated Derivatives of Toluol").—MM. Beilstein and Kuhlberg.—This essay is too lengthy for abstraction; the subject, moreover, has been already abstracted from another German publication.

On Oxylohydroxamic Acid. Dr. H. Lossen. This acid is a solid substance, difficultly soluble in cold water; submitted to a higher temperature it is slowly decomposed; when suddenly heated to 105°, it detonates; boiling for a length of time with water does not decompose it; on being boiled with caustic potassa solution it is converted into oxalic acid: nitric acid decomposes it completely and very rapidly. This acid consists, in 100 parts, of:—C, 20·00; H, 3·33; N, 23·33; O, 53·34. Formula, $C_2H_4N_2O_3$. The author describes, at great length, a series of salts of the oxylohydroxamic acid.

Researches on Mesitylen (sixth series).—Some Newly-Discovered Derivatives of Mesitylen.—MM. Fittig and Hoogewerf.—This essay has been noticed by us already, since an abbreviated account of the subject herein refered to was published in another German periodical published previous to this number of the *Annalen*, and noticed by us.

Chemical Constitution of Glycerine and its Derivatives.—M. Kolbe.—The learned author of this monograph starts from the hypothesis that glycerine should be equal to—

$$\left.\begin{matrix} CH_2 \\ CH_2.HO_{II} \\ HO \\ HO \end{matrix}\right\} C;$$

and next states that glycerine contains the elements of two groups of methyl, constituted in the following manner:—

$$\left.\begin{matrix} CH_2.HO \\ CH_2.HO \\ H \\ HO \end{matrix}\right\} C, \quad \text{and} \quad \left.\begin{matrix} CH.(HO)_2 \\ CH_2 \\ H \\ HO. \end{matrix}\right\} C.$$

The author then reviews such a lengthy series of compounds, and takes such extensive excursions over the immense field of organic chemistry, that it is impossible to compress into a small space even a minute fraction of this monograph, to which, therefore, we will not allude any further, especially as it is more a philosophico-chemical dissertation on an abstruse subject than of direct practical application.

Journal für Praktische Chemie, No. 7, June 15, 1869.

The following original papers are found in this periodical:—

On Sanguinarin, its Properties and Composition.—M. Naschold.—Sanguinarin is so named because it is prepared from the *Sanguinaria canadensis*, but it also occurs in the *Chelidonium majus*, and *Glaucium luteum*: it is an alkaloid which, in pure state, is a crystalline, white-coloured solid; formula, $C_{17}H_{19}NO_4$. As a peculiarity, the author observes that the estimation of the nitrogen contained in this substance cannot be satisfactorily executed with the well-known soda-lime process, but has to be performed by Dumas's method. The author describes, at length, several combinations of sanguinarin with the chlorides and cyanides of platinum, its behaviour towards reagents, and its products of decomposition, but none of these are so precisely characteristic as thereby to render it easy to distinguish and detect sanguinarin from all other alkaloids.

Brandy obtained from Reindeer Moss.—M. Stenberg.—This paper contains, translated from a pamphlet published in Swedish, a more extensive account of a subject to which, some time since, we referred in our columns, and, since it is of no importance, except where the *Cladonia rangiferæ* is found, we make no further abstract of this paper.

Estimation of Sulphur. Dr. G. J. Mulder.—The author speaks of the estimation of sulphur in such substances which contain carbon and sulphur together, and are not very volatile, and are, at the same time, free from any ash or incombustible matter. A certain quantity of the substance wherein the sulphur has to be estimated is weighed off in a porcelain capsule; there is next added a weighed quantity of finely-powdered nitrate, or acetate of lead; next, some nitric acid, the strength of which depends upon the nature of the substance to be assayed; and, lastly, a few crystals of pure nitrate of ammonia are added. The contents of the porcelain vessel are now carefully evaporated to dryness, ignited, and weighed. Since the weight of the oxide of lead derived from the acetate or nitrate employed is known, the increase of weight of the capsule and contents is due to the sulphate of lead which has been formed from the sulphur originally contained in the substance submitted to experiment. This method also yields accurate results when, besides sulphur, there may be iodine and bromine present, and also lead; the method may be used, also, for the estimation of phosphorus, when, in substances containing both that element and carbon, it is desired to estimate the former quantitatively, provided, of course, sulphur be absent.

Products of Decomposition of Legumin when Boiled with Dilute Sulphuric Acid.—M. Ritthausen.—The author states that, while he was engaged studying the products of decomposition of legumin and conglutin, he discovered a nitrogenous acid, which contained, in 100 parts:—C, 39·46; H, 6·14; N, 12·04; O, 42·36. This acid was called, by the author, leguminic acid. On resuming his investigations on this subject, he finds, as explained in this paper, that the acid just alluded to is a mixture of two amine acids—to wit, asparaginic acid, $C_4H_7NO_4$, and glutaminic acid, $C_5H_9NO_4$; both these acids are homologous—both are solid crystallisable substances, yielding, among their products of decomposition, by the action of nitric acid, malic and glutanic acids.

Gewerbsblätter fur das Königreich Würtemberg, Nos. 5 and 6, 1869.

This periodical rarely contains anything but matters relating to applied mechanics and agriculture; in this number, however, we meet with a paper—

On Cyanine.—M. Morat.—The author says that the colouring matter of flowers consists—1st, of cyanine, or a blue pigment; 2nd, a rose, or pink-coloured matter, in reality identical with the first, and only altered by an acidity of the juice; 3rd, two yellow-coloured matters—xanthine, insoluble in water, and xanthéine, soluble in that liquid. Cyanine is best prepared from the petals of violets or iris flowers; by exhausting these with boiling alcohol, a blue solution is obtained, which solution, however, soon turns brown, but is restored to its primitive colour by being shaken up in contact with air. In order to obtain the colouring matter in a pure state, the alcoholic solution is evaporated to dryness on a water-bath, and the residue taken up with water, wherein the blue pigment is soluble, while fatty matter and resins are left behind; the aqueous solution is precipitated by acetate of lead; the ensuing green-coloured precipitate is decomposed by sulphuretted hydrogen, filtered, and washed, and the filtrate next evaporated to dryness upon a water-bath; the residue is exhausted with absolute alcohol, and the cyanine precipitate from its solution therein by ether. Cyanine does not crystallise, is soluble in water and alcohol, and insoluble in ether; acids turn it red, and alkalies green—it is a very highly sensitive reagent for both. Reducing agents decolourise cyanine; oxygen restores the colour. The red colouring matter of flowers is extracted in a similar manner, and, once isolated, exhibits characters identical with cyanine.

On Oenoline.—M. Morat.—Oenoline is the colouring matter met with in genuine red wines obtained from grapes; it is obtainable by treating the wine with basic acetate of lead; the ensuing precipitate is collected on a filter, washed, dried at 100°, and placed in a displacing apparatus, and while therein there is poured over the dry precipitate anhydrous ether, previously saturated with dry hydrochloric acid gas. There runs off a brown-coloured liquid; the precipitate is washed with anhydrous ether until what runs off ceases to have an acid reaction. The residue in the displacing apparatus, which now exhibits a bright red colour, is treated with alcohol of 36° Beaumé, which thereby assumes the same bright red colour. The alcoholic solution is concentrated, by evaporation, to a small bulk, and water is next added; this causes the colouring matter to precipitate as a red-coloured flocculent substance, insoluble in ether, very difficultly soluble in water, soluble in alcohol, and insoluble in benzol. By a long-continued boiling in water, this colouring matter is changed, becomes brown, and loses its solubility in alcohol. The solution of the unaltered red pigment in dilute alcohol exhibits the following reactions:—Chlorine water and chlorine gas destroy the colour, producing thereby a yellow substance soluble in water; caustic potassa causes, first a blue, and next a brown colouration; lime-water yields a yellowish precipitate; bicarbonate of soda in aqueous solution, and aqueous solution of chloride of calcium, cause a blue colouration; solution of alum causes a brighter red colouration; hydrochloric acid effects no change; with nitric acid, a yellowish flocculent matter is thrown down; acetate of lead causes a blue precipitate; nitrate of lead produces a violetish red precipitate; acetate of copper yields a chestnut-brown coloured precipitate. This red colouring matter is composed according to the following formula: $C_{10}H_{10}O_5$. Young red wines contain, moreover, a pigment, soluble in acetic and butyric ethers.

with a bluish violet colour, becoming green by ammonia, and finally turning brown. Some chemists consider that this material is identical with cyanine; it is not a very stable compound, and is only met with in young wines. The colouring matter of wine is of some interest, as affording a means for detecting adulterations and artificial substitutes of wine.

Polytechnisches Journal von Dingler, second number for May, 1869.

Among the original papers, other than those relating to mechanical art and purely practical engineering, we meet here with a lengthy essay on the—

Conditions which are required for the Formation of Hypochlorite of Lime.—MM. Tschigianjanz, Fricke, and Reimer.—The authors, who have most thoroughly investigated this subject, begin their essay with the statement that, in practice, as well as in theory, a real influence has been ascribed to the moisture and state of hydration of the slacked lime which is submitted to the action of the chlorine gas; next, they review the opinions and labours on this subject of MM. Weisz, Morin, and Houton-Labillardière, Dr. Ure, Dr. Muspratt, Prof. T. Graham, and, lastly, Dr. Bolley. Curiously enough, the opinions of these learned gentlemen vary, and even to such an extreme that, whereas some of them assert that dry hydrate of lime (slacked lime) is capable of taking up 40, or even 50 per cent of chlorine gas, some of them declare that hydrate of lime, dried at 100°, does not take up any chlorine gas at all. The authors of this essay, fully convinced that men of eminently high standing in scientific matters, and especially Prof. T. Graham, were not likely to err in their observations, were led by an observation, made by the last-named *savant*, that lime dried over sulphuric acid in the vacuum made by an air-pump behaved differently towards chlorine gas from that dried at 100°. To investigate this subject fully, the authors of this essay commenced by procuring good pure caustic lime, a matter of far more difficulty than one would imagine at first. They succeeded in obtaining this material by taking the caustic quick-lime of commerce, made from pure mountain limestone, soaking that material with oil, and burning or igniting it a second time, after having placed it in a crucible heated in a furnace with coke and charcoal, and a strong blast produced by a pair of blacksmith's bellows. Quick-lime, thus prepared, when placed in water, is instantaneously converted into hydrate of lime, while there is produced, at the moment of contact of the quick-lime and water, a hissing noise, as if of a piece of red-hot iron quenched with water. The authors also prepared a quick-lime from pure white marble, soluble in very dilute hydrochloric acid, without residue; they took care that, whenever they dried the hydrate of lime intended for their experiments, to exclude the access of carbonic acid gas from that hydrate. They next repeated Prof. T. Graham's experiment, working comparatively drying weighed quantities of slacked lime over sulphuric acid, as well as by means of heat, passed chlorine over these quantities for 1½ hours, and expelled excess of that gas, left uncombined by means of a current of dry air free from carbonic acid. The results of their extensive labours are:—1st. Slacked lime, retaining even as small a quantity as 0·4 per cent of water (as is the case with that dried over sulphuric acid *in vacuo*), and any larger quantity of water retained is sufficient to effect the formation of hypochlorite of lime at any temperature. 2nd. Hydrate of lime, dried at 100°, or even at 130°, is converted into hypochlorite of lime, even at 0° (32° F.), provided the lime is freely allowed to become heated by the absorption of chlorine gas; but, if by means of keeping the temperature at 0°, or even lower, the lime is prevented becoming heated, no action at all, or only a very slight one, took place. The authors call attention to the often-overlooked fact that it is very difficult to obtain a chlorine gas quite free from hydrochloric acid gas, against which they have taken peculiar precautions in the course of the experiments just alluded to.

Behaviour of Chlorine, Iodine, and Bromine towards a Solution of Permanganate of Potassa.—M. W. Lindner.—The author says, when, to any solution containing a compound of iodine, a drop of a dilute solution of permanganate of potassa is added, the peculiarly characteristic colour of the latter substance is changed into brown—that is to say, that iodine is set free and the permanganate reduced. It does not matter whether the original solution of the iodide has an acid or an alkaline reaction, for, in the former case, the fluid will be clear and transparent, in the latter turbid. A neutral solution of a bromide is not affected by the permanganate, neither is an alkaline solution; but if the solution of the bromide is acidified with nitric acid, the reaction, on addition of the permanganate, takes place in the same manner as for the iodide solution. A solution of a chloride is never, under any conditions, acted upon by the permanganate. The author states that, even when solutions of iodides or bromides are so dilute as hardly to be detected by nitrate of silver, the permanganate never fails to detect the presence of them, but does not, at the same time, distinguish between iodine and bromine, for which purpose the specially-distinguishing reagents for these two halogens have to be applied.

Les Mondes, July 8, 1869.

We find in this paper the following original communications:—

Agronomical Map of France.—M. Delesse has received, from every canton the empire is subdivided into, two average samples of the arable soil of each of these small districts, taken at a depth of 15 centimetres below the surface. The author has thus in hand 6000 samples, and proposes, after chemically and mineralogically testing and classifying them, to employ the information thus obtained in constructing an agronomical map of France, whereupon the nature of the soils of the divers localities will be clearly indicated.

Electrical Phosphoroscope.—M. Laborde.—This instrument is based upon the same principle as that of M. Becquerel; its essential parts are a Ruhmkorff induction apparatus, the spark of which throws light on the phosphorescent object, and of a sliding frame, one of the ends of which hides the object during the brief moment it is illuminated by the electric spark. This sliding frame is 40 centimetres in length by 10 centimetres in breadth; it is fixed at its centre on an axis, which may be made to move rapidly by means of a pedal. The arrangement of this apparatus, which is rather confusedly described in the original, and could not be well understood without a diagram, is such as to render it serviceable for studying the phosphorescence excited by a blow, as well as by friction. The phenomena of phosphorescence of substances which, like nitrate of uranium, is only of very short duration, can be observed by means of this instrument equally well as the long-continued and strong phosphorescence induced by friction in pieces of porcelain or glass.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 197, May, 1869.

The greater part of this periodical is devoted to mechanical science. The only paper of interest to chemists is a lengthy report on the—

Manufacture and Use of Animal Phosphated Chlorinated Manure.—Dr. Boucherie.—All farmers know that now and then it happens that horses, cattle, or sheep die; and it is chiefly the disposal of their carcases which the report here alluded to treats of. The skin is taken off, and, after having been disinfected, is sold; the intestines are mixed with quick-lime, and buried in a spot to be always kept for such a purpose; the remainder of the carcase is cut into pieces weighing from 5 to 6 kilos., and placed in a wooden tank lined inside with lead, and of about 120 cubic feet capacity. Water is added to the remains of the dead beast, bones included, and about 400 kilos. of crude commercial hydrochloric acid; ebullition is effected by means of the introduction of steam, obtained from the portable steam boiler; after boiling for about six hours, the entire mass is disintegrated. In order to destroy the very unpleasant smell resulting from this ebullition, some lumps of peroxide of manganese are added, whereby a slow but constant disengagement of chlorine gas, is obtained, and all disagreeable smell avoided. When the liquid and contents of the tank are thoroughly cold, the solidified fat which floats on the top is taken away, and fit for the soap or candle maker; the clear liquid is run off and mixed with 200 kilos. of coprolite powder, or bone-ash, and thus converted into a useful manure. At the bottom of the tank will be found a brownish-coloured pulpy mass, which has lost all traces of organised structure, and this materia., after having been mixed with some mineral phosphate, is also applied as manure. The following is the composition, in 100 parts, of the liquid manure here alluded to, previous to its being mixed with mineral phosphate:—Water, 79·60; organic matter (containing 1·28 per cent of nitrogen), 10·65; ash (containing 2·38 per cent of phosphoric acid), 9·45. The browniah pulpy mass contains, in 100 parts:—Water, 16·75; organic matter (containing 3·90 per cent of nitrogen), 31·17; ash (containing 8·20 per cent of phosphoric acid), 52·08. The quantity of materials obtained at each operation is stated to amount to about 70 kilos. of fat, 1500 litres of liquid, and 700 kilos. of brownish pulpy animal matter; these quantities, however, will vary according to the size, weight, and nature of the animals so disposed of. This process is recommended above the burial of dead animals; and in some communes of France, it is already ordered to be adopted in all cases, since it is a useful addition to the sanitary regulations of the country.

NOTES AND QUERIES.

Powdering Isinglass.—Isinglass, owing to its toughness, is a substance which it is almost impossible to reduce to powder by means of pestle and mortar; but, akin to horn, to cork, and such-like substances, it may be obtained in pulverulent shape by means of a sharp, well-hardened, but not too coarse file. Lump isinglass answers best for this purpose.

Pattinson's Method for Extracting Magnesia from Limestone Rocks.—Would any correspondent obligingly give me the process of extracting magnesia from the limestone rocks containing that earth, by Pattinson's method; it appears to be accomplished by carbonic acid.—W. R.

TO CORRESPONDENTS.

Communications have been received from Dr. Wood; Mawson and Swan; W. H. Preece (with enclosure); C. Martin; Dr. F. C. Calvert, F.R.S.; F.E.S.J.; J. S. Parker; W. Hawkesworth; W. Sim (with enclosure); Smith and Son (with enclosure); Dr. E. Schunck, F.R.S.; Ritchie and Sons; Dr. S. Muspratt; C. Bailey; W. N. Hartley; G. G. Walmsley; J. Fordied; H. Mayne; G. Clarke; J. Winter Jones; S. E. Phillips (with enclosure); G. F. Rodwell; J. Wilkinson and Co.; and L. F. Haseler, Queensland, Brisbane.

THE CHEMICAL NEWS.

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ON SOME GENERIC REACTIONS IN ORGANIC CHEMISTRY.

By S. E. PHILLIPS.

ORGANIC chemistry has been variously defined: I would represent it as essentially "the chemistry of generic reactions."

It is mooted that a fuller recognition, and a more systematic study of a few widely-generic reactions, may do much to bring about a more simple outline classification of the vast wonders of organic combinations.

These reactions have been recognised in their simplest expressions; but it has not been so clearly shown that they extend into regions of great intricacy, where the guidance of law is so much needed in the discrimination of complex types of combination.

Astronomy and geology have aspects of immensity which engage and entrance the noblest powers of human intellect, nor is chemistry in any way inferior as another receding horizon of infinity.

These aspects are, indeed, the inverse of dissolving views, for it is the reward of genius, of labour, and sacrifice, to decipher, out of the dim chaos, minarets and pinnacles of architectural beauty, which entrance the mind and afford a pleasure that never satiates: and every line traced adds a new lustre, and a richer meaning, to those already drawn.

Moral and physical truth have a distinction only in a human or circumferential sense. All aspects of divinity coalesce and commingle towards an effulgent centre of infinite harmony; hence poets have been co-labourers with our profoundest philosophers and physicists in promoting the conviction that—

> "Discord is harmony ill-understood;
> All partial evil, universal good."

In offering these thoughts as an amateur, in presence of men whose abilities and means of investigation are greatly superior, some apology or explanation may be desirable.

The sincere desire is to write in a humble spirit of enquiry, rather than of dictation.

It is true that most English chemists have adopted the new notations; but, seeing that in the continental journals fully one-half the articles are written in old style, and that so great an authority as Dumas does not hesitate to express entire inabillty to read modern chemical memoirs, owing to their complex types and "barbarous" nomenclature, surely it may be forgiven in an unpretending student to express long-pent-up thoughts in what appears to him as the clearest and simplest language, the more so as his object is purely to ventilate principles (which are independent of modes of representation), and also to challenge students of the modern ways, to see if they can penetrate deeper or see further into the wonderful labyrinth.

The pretentious methods of modern notation are certainly curious in their way; and it is refreshing to see the tone of sober-minded reaction which has been evinced at the recent discussions of the Chemical Society.

One of the most prominent facts of general chemistry is that hydrides are "indifferent bodies"—they do not combine without decomposition—yet Professors Hofmann and Wanklyn see in these prolific sources of substitution, and even of direct dedoublement; they are prominent in the diamines and triamines of the former, and to the latter they are leading types to which other definite chemical combining bodies may be referred:—

Ethylene. $C_4\begin{cases}H\\H\\H\\H\end{cases}$ Hydride of ethyl. $C_4\begin{cases}H\\H\\H\\H\\H\\H\end{cases}$

Rosaniline. $C_4\begin{cases}NHC_{12}H_5\\NHC_{12}H_5\\NHC_{12}H_5\\H\end{cases}$ Leucaniline. $C_4\begin{cases}NHC_{12}H_5\\NHC_{12}H_5\\NHC_{12}H_5\\H\\H\\H\end{cases}$

M. L. Henry holds that salicylic alcohol is an *aldehyde* as well as a *phenol*, and that by chloro-variation it gives the following series:—

Salicylic alcohol, $C_6H_4<^{HO}_{CHO}$

Doubly-chloruretted cresol, $C_6H_4<^{HO}_{CHCl_2}$

Triply-chloruretted toluol, $C_6H_4<^{Cl}_{CHCl_2}$

Chloruretted aldehyde of salicyl, $C_6H_4<^{Cl}_{CHO}$

Whether the first really be an alcohol, or the last an aldehyde, is by no means certain, or even apparent, so random are these type-building speculations. And it seems strangely overlooked that the old radical theory is, peradventure, adequate to explain all these substitutions without any such paradoxical nomenclature.

The first pair, as *hydrides*, would be—

$(C_{14}H_5O_4),H$ and $(C_{14}H_5O_2),H$;

the second pair are evidently chlorides—

$(C_{14}H_5Cl_2);Cl$ and $(C_{14}H_5Cl_2O_2),Cl$;

as *alcohols*, the first pair would be—

$(C_{14}H_5O_2)O+HO$ and $(C_{14}H_5Cl_2)O+HO$

Another authority, speaking of an acid derivative of mesitylen, $C_{18}H_{11}H$, says $C_9H_6O_6-3CO_2=C_6H_6$, therefore it is a benzol with 3(COHO), substituting 3H!

In order to parallel the cogency of this logic, I would say of the thousands or millions of organic bodies which similarly break up into oxalic acid, that, therefore they are oxalic acids with the infinity of residues replacing, &c., &c.

M. Schorlemmer, before the Royal Society (CHEMICAL NEWS, vol. xix., p. 196), similarly says, the oxidation products of propylic glycol are carbon dioxide, and acetic acid, which proves that the structure of the glycol is expressed by the formula $CH_3—CH(OH)—CH_2OH$.

Another authority, with like wonderful prevision, says that hydrocinnamic acid is $C_6H_6+CH_2-CH_2-COHO$, and the saltic type is $(C_9H_9O_2)_2Ca+1\frac{1}{2}H_2O$.

Another insists that the acid, with 2H less than cinnamic acid, $C_{18}H_7O_2+HO$, and therefore $C_{18}H_5O_3+HO$, coumaric acid, is phenyl-propiolic acid—

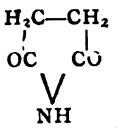
$$C_6H_5C$$
$$\|$$
$$C$$
$$|$$
$$CO_2H$$

Professor A. Matthiessen thinks that all the reactions of narcotine may be accounted for by the following rational (?) formula:—

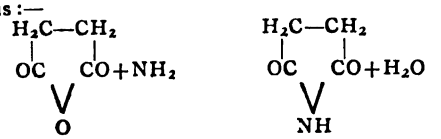
$$\left.\begin{matrix}CH_3\\(C_{11}H_9O_2)'''\\(C_8H_4O)''''\\(CH_3)_2H\end{matrix}\right\}N\Big\}O\Big\}O_3$$

By a singular distortion of an intellectual process, some have thought that the simple principles of mineral

chemistry might be employed to gradually unravel the greater complexities of organic combination. Professor Wanklyn has corrected this error, and shown that, in the simple salts and hydrates of soda, lie hidden the mysteries of triatomic and septatomic quantivalence: we must not go from the simple to the complex, but rather work out principles or fantasies from organic chemistry, and then apply them to the old binary compounds of mineral chemistry. Time was when the relation of acid to amide was a matter of great simplicity, but M. Erlenmeyer now sees much farther. Succinimide is—



and its origin from anhydrous succinic acid and ammonia is thus:—



To give but a faint description of these modern pleasantries of atomic mechanism would fill large volumes. We can only add in this brief glance, that they are from men of undoubted eminence and great practical ability.

Enough has been said to justify our hesitation in adopting any of these multifarious modes, and in the pressing desiderata to lay hold of some wide generic principles which may afford some comprehensive grasp of the whole contour of organic metamorphosis; we humbly, and *pro tem.*, fall back on the old binary principles of Berzilian and Lavoisierian chemistry, as best fitted for the widest and most comprehensive grasp.

We assume, until a wider and better theory can be offered, that such radicals as methyl (C_2H_3), ethyl (C_4H_5), propyl (C_6H_7), acetyl (C_4H_3), and a vast infinity of analogues do exist, and that, as hydrides, they are characteristic indifferent bodies, while with O, Cl, S, and other negative elements they form bases or acids, and other more neutral bodies, perfectly paralleled by the more simple elements of mineral chemistry.

The confidence and dogmatism with which such types and names as we have indicated are obtruded upon notice will be in no way imitated. We shall try to lay hold of leading types, ever bearing in mind that they must necessarily be subject to manifold ways of isomeric variation. The ground to occupy is of too wide and extensive a character to permit of special exactitude; but this attitude should in no way be opposed to rigid scrutiny or microscopic investigation at any stage of the process. The harvest is indeed ripe, and manifold labourers are wanted in every direction; workers in the laboratory and watchers of the wide horizon. Our meaning in this direction will perhaps be better understood by an illustration.

We deem, then, the term phenyl-propiolic acid almost as barbarous as the older term, "sulphuric ether." Now that we have an infinity of ethers, including a true sulphuric ether, it surely behoves us to carefully control their nomenclature.

In what way the radicals phenyl and propyl may combine to form the acid in question is a legitimate matter of detail, nor can we afford to wait long upon such minutiæ. To us the great question is, Is there a hydrocarbon radical ($C_{18}H_5$) comparable with acetyl (C_4H_3), or cinnamyl ($C_{18}H_7$), &c., &c.?

Our meaning may further be seen in regard to the body aceton, $C_6H_6O_2$. Its origin and subsequent reactions led very generally to the idea of its being a hydride of acetyl, $C_4H_3O_2,H$, in which the H was replaced by the gaseous methyl, $(C_2H_3) = C_4H_3O_2,C_2H_3$.

While recognising the validity and value of this aspect as one of the elements of isomeric variation, yet would we stoutly urge the great necessity for a due subordination of this phase of organic combination. To give it undue prominence, as is too often done, and coin a shibboleth of hard names, is positively confusing and detrimental.

It has only just transpired that, by the simple and direct oxidation of the hydrocarbon propane or hydride of propyl, we get a body possessing all the characters of acetone, $C_6H_5O_2,H$.

The distinction between the two types is one of great importance, because the hydrocarbons proper are comparatively few and capable of a simple generic classification, while such types as acetone, $C_4H_3O_2,C_2H_3$, are capable of an infinite variation, nor do I see any hope of embracing them in any generic arrangement.

It only remains in this short introduction to offer a few thoughts as to why we still adhere to the old notation in regard to O, S, C, and other doubled atoms of modern theory.

Among other reasons, O is doubled because its ordinary volume is half that of H. The same anomaly subsists in the volumetric character of the phosphorus, arsenic group, and some have pushed theory so far as even to double these, but that is generally discountenanced on the ground that the anomaly disappears in their various compounds, where the volumes agree with the atomic weights in a way perfectly comparable with the one volume, N.

			Density.	Atomic Weight.
Ammonia ..	H_3,N	2 vols.	17	17
Phosphonia ..	H_3P	,,	34	34
	&c., &c.			

We moot that the same argument is strictly applicable for oxygen also.

It is monatomic and replaces chlorine, &c., in organic radicals where the volumes correspond normally; in other words, the densities are as the atomic weights.

			Density.	Atomic Weight.
Hydride of acetyl	$(C_4H_3O_2)H$	2 vols.	22·04″	44
	$(C_4H_3Cl_2)H$	,,	49·70″	99
	&c., &c.			

Hydrides are normally two vols., whence their densities are half their atomic weights, but these radicals themselves are normally one vol., and their densities exactly correspond with the atomic weights.

		Density.	Atomic Weight.
H	1 vol.	1	1
$(C_4H_3O_2)$ ..	,,	43	43
$(C_4H_3Cl_2)$..	,,	98	98
	&c., &c.		

Also in organic acids the densities and atomic weights agree in innumerable cases of proto-, sesqui-, bi-, and tri-acid forms where chlorine and oxygen are perfectly paralleled.

Again, oxygen, in conjunction with C = 6, and S = 16 replaces H in ammoniacal types, and here also the densities and atomic weights agree.

	H_3N.		Density.	Atomic Weight.
Ammonia	HH_2,N	2 vols.	8·5″	17
Ethyl mustard oil	$(C_4H_5)(CS)_2,N$	,,	43·7″	87
Methyl ,,	$(C_2H_3)(CS)_2,N$	,,	37·8	73
Amyl ,,	$(C_{10}H_{11})(CS)_2,N$	,,	63·4	129
Butyl ,,	$(C_8H_9)(CS)_2,N$			
	&c., &c.			

and, by a generic action, these, by addition of ammonia, form fluosinnamin types of sulph-ureas.

Urea	$H(CO)_2H_3N_2$
Fluosinnamin ..	$(C_6H_5)(CS)_2H_3,N_2$
Butyl sinnamin ..	$(C_8H_9)(CS)_2H_3,N_2$
&c., &c.	

Lastly. Monatomic oxygen replaces H in the general phenomena of substitution, mainly like chlorine.

The oxidations, chlorodations, and sulphodations of carbydrogens, rich in hydrogen, present a unity of action; and the bases split up to negative or acid forms, by similar intermediate stages of hydride or indefinite bodies, where O = 8; S, 16; and Cl, 35·5, replace each other with volumes and atomic weights in perfect harmony.

We now take a glance at the amide and glucoside modes of production.

AMIDES.

The study of these bodies some years ago afforded the writer great interest:—

1. As possessing such new and varied phases of ammoniacal type.

2. As proving the adequacy of plain and simple principles to guide without ambiguity or mystification into the profound depths of the science.

3. As proving that *one generic formula of reaction* or production seems to give amides, hydramides, ureides, or ureas, amide acids, urethanes, &c., &c.

4. As providing the strongest arguments against the modern doctrines of mono-, bi-, and tri-basic acids, and the similar mono-, bi-, and tri-amines.

In this connection I can only refer to one aspect of this wide field, viz., its tendency to resolve hitherto unexplained groups of organic combination. If I mention two such groups it is not so much because success appears to attend the very onset, as to elicit a co-operative or corrective criticism.

On the one hand, I have long felt puzzled at the existence of an apparently aberrant group of carbohydrogens with even instead of odd ratios of H, and have marked out for investigation what may, perhaps, be called *the malic acid group*.

This group is exceptional in the even number of H atoms in the radical, whereas all other acid series have only odd numbers of H. A special study of this group might throw some light on the problem why all the carbon constituents have even numbers, and the H part odd numbers, while the oxygen seems normally to affect even numbers in the radical.

The first step in the process is evidently to apply the generic formula in question, and the peculiarity seems to stand that test, for

Malate of A − 2HO gives MALAMIDE .. .. $(C_4H_3O_3)H_2N$
Bimalate of A − 2HO „ MALAMIC ACID (ASPARTIC) $2(C_4H_3O_3)H_2N,O$
Aspartate of A − 2HO „ ASPARTAMIDE (ASPARAGIN) $2(C_4H_3O_3)H_4N_2$

Most books say that malamide or asparagin is found in the asparagus, in marsh mallow, and some other plants, but, although of the same composition, they are not identical, and I think my notation and a recognition of the ureal or atmonia type of asparagine will clear up the difficulty. I cannot see the least reason or advantage in doubling this acid to make it square with the modern notion of bibasic acids.

In "Fownes" (9th edition), its structure and derivation is compared with that of the oxamide series. In both cases, the acids and neutral salts are doubled, while the acid salts (binacids?) and their derived amides contain no more acid than the mono or neutral forms, and yet the prefix *bi* is retained.

I ought, perhaps, to have pointed out that, by an extension of the formula, when the acid is an ammoniacal one, then the result is an ureal amide, thus—

Carbamate of A − 2HO = UREA .. .. $2(CO)H_4N_2$
Aspartate of A − 2HO = ASPARTAMIDE (asparagin) $2(C_4H_3O_3)H_4N_2$
&c., &c.

On the other hand, there seems a tolerably wide range of combination with unusual and intractable ratios of oxygen, and with little or no H in the compound, as in the

Mellitates, $HO+C_4O_3$
Croconates, $HO+C_5O_4$
Rhodizonates, $HO+C_7O_7$
Saccharates, $HO+C_6H_4O_7$
&c., &c.

How, then, does this generic action apply to such cases?

Carbonate of Ammonium − 2HO, gives Carbamide.
Bicarbonate of „ „ „ Carbamic acid.
Oxalate of „ „ „ Oxamide.
Binoxalate of „ „ „ Oxamic acid.
Benzoate of „ „ „ Benzamide.
Bibenzoate of „ „ „ Benzamic acid.

$$H_4NO+CO_2-2HO=(CO)H_2N$$
$$H_4NO+2CO_2-2HO=2(CO)H_2N,O$$
$$H_4NO+C_2O_3-2HO=(C_2O_2)H_2N$$
$$H_4NO+2(C_2O_3)-2HO=2(C_2O_2)H_2N,O$$
$$H_4NO+C_{14}H_5O_3-2HO=(C_{14}H_5O_2)H_2N$$
$$H_4NO+2(C_{14}H_5O_3)-2HO=2(C_{14}H_5O_2)H_2N,O$$
&c., &c.

The infinity of amides thus produced are hydride, indifferent or non-combining bodies, mostly affecting the crystalline form of needles, and insoluble; in all probability they are of the type H_2N,H. Whatever ammonia is in type, constitution, and general properties, that, in all probability, are the amides.

The amic acids are ammoniums, H_4N,O, definite combining bodies, and de-doubling with basic, intermediate, or acid functions just in proportion as the substitutional equivalents rank higher or lower in the electro series.

Malate of Ammonium − 2HO gives Malamide.
Bi-malate of „ − 2HO „ Malamic (aspartic) acid
Succinate of „ − 2HO „ Succinnamide.
Bi-succinate of „ − 2HO „ Succinnamic acid.
&c., &c.

It is curious to compare these simple and consistent notations with the confused variations of modern theory. Any fundamental appeal to the guidance of law is wholly lost in the doubling of atoms, and the varied estimates of water of hydration in the several compounds submitted to the amide formula.

In extending this list considerably, I am well aware there are chemical reasons for doubling the atom in some cases where, indeed, that process may, in all probability, be necessitated: I only contend that this should be done with extreme caution, and not without a survey of the several relations.

As to the doubling of succinic acid, I find the following remark in my rough notes:—"M. Fehling, and also M. Cahours, seem quite sure that succinic acid is tribasic, like the phosphates $3HO+C_8H_3O_5$; and, between the chemical reasons urged by the bi- and tribasic claimants, I could not see a pin's difference whereon to found a preference; but, where all is so empirical, the simple truth may have a strong advocate in M. Dopling, from whose elaborate paper I copy an extended series of succinates $(MO+C_4H_2O_3)$, with the usual variation of type in ascending the series into the weaker bases, where two and three atoms of base are found, as in the corresponding acetates, sulphates, &c."

Many salts affect two volumes, but there are several whose densities are as one volume, as in the

Succinate of ethyl, $EO+C_4H_2O_3$,
Succinate of methyl, $MeO+C_4H_2O_3$,
Oxalate of ethyl, $EO+C_2O_3$,
Silicate of ethyl, $EO+SiO_2$,
Oenanthate of ethyl, $EO+C_{14}H_{13}O_3$,

and others.

The theoretical application of this formula to the second group would be thus—

Mellitate of A − 2HO = Mellitamide?
Bi-mellitate of A − 2HO = Mellitamic acid?
$$H_4NO+C_4O_3-2HO=(C_4O_2)H_2N?$$
$$H_4NO+2(C_4O_3)-2HO=2(C_4O_2)H_2N?$$

There is encouragement to think that these bodies may be obtained when duly sought for. Fownes says, "Mellitate of A yields, by distillation, two curious compounds—paramide, a white, amorphous, insoluble substance, containing C_8HNO_4 (*i.e.*, bimellitate of ammonia − 4HO), and

convertible, by boiling with water, into bimellitate of ammonia;" and euchronic acid, a colourless, soluble, crystalline body, containing, in the anhydrous state, $C_{12}NO_6,2HO$.

In this case, it is almost certain that paramide is the amide or ammonia form of mellitamic acid, evincing as it does the widely generic property of re-conversion, by boiling water, into bimellitate of A.

Here, then, we get a new substitutional representative of H; and, if one H can be replaced by (CO), (C_2O_2), or (C_4O_2), surely that does not end the series; and have we not more complex acids which may be explained by a similar process, and their radicals identified?

And, seeing that silicium is now so close a congener with carbon, may not a similar extension of law be applicable in the infinitely varied silicates of mineralogy?

Euchronic acid appears to be a varied mellitamic acid—thus, $3(C_4O_2)HN,O$.

Glucosides.

The manuals of chemistry present a strange variety of types in regard to the constitution of the sugars, and also complex acids containing higher ratios of oxygen; but there are considerations which seem to encourage the hope that both these intractable groups may, ere long, be embraced within the limits of simple law.

The hypothesis herein is twofold; 1st, That glycols, glycerines, mannites, and sugars are all monatomic alcohols; 2nd, That complex organic acids with high ratios of oxygen are substitutional variations of simpler types.

For a fuller exposition of these views, I must refer to a separate article on the constitution of the alcohols; but, for brevity, I here append a note on the aceto-nitrates, or, as I should prefer to call them,

Nitro-Acetates.

It is said that these belong to the water type $\left.\begin{matrix}H_6\\H_6\end{matrix}\right\}O_6$, in which H_6 is replaced by ferricum $Ffe^{vi.}$, and 1H is replaced by (NO_2)

No. 1.
$\left.\begin{matrix}H_6\\H_6\end{matrix}\right\}O_6$
Type.

No. 2.
$\left.\begin{matrix}Ffe^{vi.}\\H_6\end{matrix}\right\}O_6+2H_2O$
Normal ferric hydrate.

No. 3.
$\left.\begin{matrix}Ffe^{vi.}\\4(C_2H_3O)'\\(NO_2)'\end{matrix}\right\}O_6+4H_2O$
Tetra-aceto-nitrate of iron.

No. 4.
$\left.\begin{matrix}Ffe^{vi.}\\3(C_2H_3O)'\\(NH_2)'\\H_2\end{matrix}\right\}O_6+2H_2O$
Tri-aceto-nitrate of iron.

No. 5.
$\left.\begin{matrix}Sr''\\(C_2H_3O)'\\(NO_2)'\end{matrix}\right\}O_2$
Aceto-nitrate of strontian.

No. 6.
$\left.\begin{matrix}Ba''\\(C_2H_3O)'\\(NO_2)'\end{matrix}\right\}O_2$
Aceto-nitrate of barium.

If, in these compounds, (NO_4) really replaces 1H of acetic acid, and, further, presuming that, in the three and four atoms of acetic acid, only one atom is so modified, then the formulæ might be thus—

(No. 6). $2BaO+AcO_3,HO$
(No. 5). $2SrO+AcO_3,HO$
$\left.\begin{matrix}\\\\\end{matrix}\right\}AcO=C_4H_2(NO_4),O_3$

(No. 4). $2Fe_2O_3+3AcO_3,7HO$
(No. 3). $2Fe_2O_3+4AcO_3,HO$
$\left.\begin{matrix}\\\\\end{matrix}\right\}1AcO=C_4H_2(NO_4),O_3$

It only remains to compare these notations with the ordinary types of similar true acetates; and methinks all seems quite fair and simple; nothing strained, nothing outlandish. No new principles, no 6-atom water types are at all requisite! As to the 6-atom *normal* ferric hydrate, it is clearly $3HO+Fe_2O_3$.

What is this ferricum if it be not 2 atoms of ferrosum? and yet this latter is said to be tetratomic, while the former is hexatomic!

Ferrosum = $Fe^{iv.}$ = (56). Ferricum = $Ffe^{vi.}$ = (112). As a general rule in such cases of substitutional variation, I prefer to retain, if possible, the supposed normal type, with a dash referring to a marginal explanation; also to retain the dash in cases where some unknown substitutional variation may be presumed.

Some vigorous effort is needed to restrain the amazing fecundity by which the multiplication of types and hard names have become a pest to the science.

				Sources.	Acid.			Base.			
1.	Acetic Ether	C_4	H_4	O_4	—	Acetic acid	HO+ C_4	H_3 O_3	+	Alcohol	$C_6H_6O_2$	− 2HO
2.	Stearine	42	42	8	Animal fats	Stearic acid	HO+ 36	35 3	+	Glycerine	6 8 6	− 2HO
3.	Bi "	78	76	9	" "	" "	HO+ 72	69 5	+	"	6 8 6	− 4HO
4.	Tri "	114	110	12	" "	" "	HO+138	103 7	+	"	6 8 6	− 6HO
5.	Salicine	28	18	14	Willow bark	Saliginine	HO+ 14	7 3	+	Sugar	12 14 14	− 4HO
6.	Populine	40	22	16	Aspen bark	—	HO+ 28	11 5	+	"	" " "	− 4HO
7.	Phloridzine	42	24	20	Cherry bark	Phloretine	HO+ 30	13 9	+	"	"	− 4HO
8.	Quercitrine	38	18	20	Quercitron bark	—	HO+ 24	7 9	+	"	"	− 4HO
9.	Esculine	42	24	20	Horsechesnut	Esculetine	HO+ 18	5 7	+	2 Sugar	2(")	− 10HO
10.	Paviine		—		Ash bark	—	—	—	+	Sugar	"	—
11.	Saponine		—		Soap wort	—	—	—	+	"	"	—
12.	Frangulin	40	20	20	—	—	HO+ 28	9 9		—	—	− 4HO
13.	Plobaphen	52	24	28	—	Oak red	—	—		—	—	—
14.	Caincin	48	39	21	Chiococca Ramosa	Chiococcin	HO+ 36	27 9		—	—	− 2HO
15.	Amygdalin		—		—	—	—	—		—	—	—
16.	Rubian		—		Madder root	Alizarin?	—	—	+	Sugar	—	—
17.	Indican		—		"Indigofera"	Indigo red?	—	—	+	"	—	—
18.	Antiarine		—		"Antiaris"	Yellow resin	—	—	+	"	—	—
19.	Murrayin	72	44	40	—	Murrayetin	HO+ 48	23 19	+	2 Sugar	2(12 12 12)	− 4HO

2 and 3.—It remains to be seen whether these substitutions take place in the acid or in the base—precedents are equally available for both cases; and this alternative applies to the whole series. The StO_3 of No. 3 would be

$$C_{36}\overbrace{H_{34}(C_{36}H_{35}O_2)}O_3,$$

that of No. 4 would be—

$$C_{36}H_{33}(C_{36}H_{35}O_2)_2O_3.$$

6.—The acid, 28 11 5, easily splits into benzoic acid, whence it may be that this acid is of type No. 5, with the radical of benzoic acid (14 5 2) replacing 1H.

7.—The acid, 30 13 9, splits into phloretic acid, HO+18 9 5, whence it may be that acid with 1 (12 5 4) replacing 1H. Phloridzine gives a characteristic ammonia phloridzeine, just as orcine gives a similar ammonia orceine; and I subsequently find orcine is associated with a lichen sugar!

18.—Antiarine is—C, 61·2; H, 8·1; O, 30·7. Its yellow resin is—C, 83·9; H, 9; O, 4·2.

These studies have afforded much pleasure in the prosecution; but, while our leading chemists are eagerly pursuing other routes, they are presented with diffidence and humility, in the hope that other minds may be induced to take stock of progress, and to enquire whither we are tending, and what are the materials elaborating in our workshops or laboratories for the popularisation of science.

PRELIMINARY NOTE ON NAMAQUALITE.

By A. H. CHURCH, M.A.

Some time ago I obtained from Mr. J. R. Gregory a few pieces of a beautiful blue silky mineral which he had obtained during his recent visit to South Africa, from one of the copper mines of Namaqualand. The qualitative examination of the mineral proved it to contain copper, aluminium, and water, with traces of calcium, magnesium, and iron. Several specimens were crushed into fragments, and the pure homogeneous parts picked out for quantitative analysis. The percentage numbers correspond pretty closely with the formula $Al_2H_6O_6,3CuH_2O_2,4aq$.

The constitution of this mineral appears to warrant the bestowal of a specific name; the locality of its occurrence suggests that of *Namaqualite*. I am engaged in completing the investigation of the physical and chemical characters of this compound; but I may now mention that it occurs in thin layers made up of short silky fibres, and is of a pale blue colour. The layers alternate with another copper mineral, which is amorphous, and is probably chrysocolla. Namaqualite has something of the aspect and texture of a soft variety of crocidolite, or of chrysotile. The absence of silica from namaqualite is remarkable. As far as at present made out, it would seem to be a cupric aluminic hydrate, hitherto unrecognised.

ON SOME MEANS FOR PREVENTING THE BUMPING OF BOILING LIQUIDS.

By HUGO MÜLLER, F.R.S.

The annoyance which arises from the bumping of certain liquids when submitted to distillation or boiling has often attracted the attention of chemists, and various means have been proposed for its prevention.

The value of pieces of platinum, charcoal, burnt clay, and other porous bodies for this purpose is well known, and, under certain circumstances are efficient enough; yet there occur very frequently cases in the laboratory when these means are unavailable.

About two years ago Pietro Pellogio (*Fresenius, Zeitschr.*, vi. Jahrg.) proposed a very simple contrivance, which was stated to act very satisfactorily indeed. It consisted of a moderately wide glass tube, passing through the cork of the tubular of the retort, and nearly reaching the bottom of it, the upper end being bent at right angles and drawn out into a capillary tube.

Having occasion to try the efficiency of this arrangement, I came to the conclusion that it was quite ineffective, and shortly after, G. Hager (*Pharmac. Centralhalle*, Bd. 9) confirmed the negative results I obtained.

Quite recently E. Winkelhofer (*Ber. d. Chem. Gesellsch. Berlin*, p. 194, 1869), proposed for the same purpose the application of an electric current, which, through the incipient decomposition of the liquid and consequent evolution of gas, causes the ebullition to become quite regular and steady. Dufour, for another, with another object in view, had made use of the same means.

The application of the electric current unfortunately pre-supposes that the liquid to be distilled is a sufficiently good conductor of electricity; and, if this is not the case, necessitates the introduction of such substances as shall cause the liquid to become a conductor. This circumstance, therefore, limits very considerably the use of this otherwise efficient arrangement, and it is on this account that I venture to bring under notice some other means which I have tested in a variety of cases, and which invariably proved satisfactory.

In cases where the introduction of any foreign matter into the liquid about to be distilled is undesirable, I introduce through the cork in the tubular of the retort a glass tube, which is drawn out to a long capillary tube and pressed tightly to the bottom of the retort. The upper end of the glass tube is connected, by means of an india-rubber tube, with a generator of carbonic acid, or hydrogen, or a gas-holder containing air, and whilst the distillation is going on, one of these gases is passed in a slow but continuous current through the liquid. Under these conditions, all bumping is avoided, and the distillation proceeds with the utmost facility.

For ordinary purposes, however, I have found it still more convenient to introduce into the liquid about to be distilled a small fragment of sodium amalgam or, in cases where the liquid is acid, a small piece of sodium-tin. Methylic alcohol is well known to be one of the most difficult liquids to distil, yet, on the introduction of a minute piece of sodium amalgam or sodium-tin, it can be distilled without the slightest inconvenience. I found on one occasion that more than 400 grammes of methylic alcohol distilled over with perfect steadiness, and without exhausting the activity of a fragment of sodium-tin, weighing not more than 0·060 grms.

It is, perhaps, hardly necessary to mention that the action of sodium amalgam and sodium-tin is due to a minute but continuous disengagement of hydrogen taking place during the process of distillation.

ON HEAT TREATED AS A SCIENCE OF KINETICS.*

By G. F. RODWELL, F.C.S.

(Continued from p. 26).

III. (Abstract).

This lecture was chiefly devoted to a consideration of the effects produced by heat within a mass of matter, and the various forms of action which it then assumes. The following definitions, which are taken from the "Notes," convey the principal points of the lecture.

The attractive force existing between the molecules of matter, like all other attractive forces, decreases in intensity as the distance between the attracting molecules increases, and *vice versâ*. Liquids become solids (*solidification*) when they lose so much of their molecular motion that the molecules approach sufficiently near to each other to produce the effect of rigidity, in place of the former molecular mobility. (α). When the resulting solid assumes a definite geometrical form (*crystallisation*), the attractive force of its molecules probably varies in intensity in different directions; thus, supposing the molecules to be spherical, the attractive force wold be greater or less in the direction of a diameter A than in the direction of a diameter B, cutting A at right angles; or, supposing the molecules to be ellipsoidal, the attractive force would be greater or less in the direction of the major axis than in the direction of the minor axis. (β). When the resulting solid does not assume a crystalline structure or form, the attractive force of the molecules probably does not vary in different directions, or the varying intensity may be equalised by extraneous causes (*amorphous solidification*).

When molecular motion is communicated to a substance, it is obvious that, before it can expand that substance, it must overcome the mutual attraction of its molecules at the particular distance at which they then exist; for expansion is the act of increasing the distance between individual molecules (*vide* Lecture II.) In thus separating the molecules, there is, consequently, a certain amount of work to be done (*the internal work of a mass of matter*), just as the separation of two masses—for instance, the raising of a weight to a height above the surface of the earth—involves the expenditure of an amount of work equal to the force of gravity which has been overcome, and, in both cases alike, heat is consumed in the per-

* A course of four lectures delivered at the London Institution.

formance of the work done. And as when a weight is raised above the surface of the earth it possesses potential energy (*vide* Lecture I.) competent, when converted into kinetic energy, to cause it to fall through the space which separates it from the earth, and to generate the heat consumed in raising it when its kinetic energy is arrested, so, likewise, the molecules of a substance expanded by heat possess potential energy (*molecular potential energy*) competent to cause them to recross the space through which they have been separated by the added molecular motion, and to generate the heat consumed in separating them when the kinetic energy thus induced is arrested.

And since all matter possesses a certain amount of molecular motion, and no two molecules are in contact, it follows that all molecules possess a certain amount of potential energy, and that the acts of heating and cooling, (addition and subtraction of molecular motion) may be expressed respectively as the increasing and the lessening of molecular potential energy, considered in regard to its amount at the time of such addition or subtraction. (The first part of this assertion may be otherwise expressed by saying that nothing is so cold that it cannot be made colder; ice may be called excessively hot when compared with solid carbonic anhydride; in a word, the former possesses a far larger amount of molecular motion than the latter. The *absolute zero of temperature* is believed to be $-273°$ C., and we must imagine that the molecules of matter would be in contact at this temperature. Matter thus constituted would be perfectly lifeless and inert; it would possess no motion, neither could its molecules transmit any motion. We have not yet succeeded in producing a degree of cold approaching the absolute zero. The rapid evaporation of liquid ammonia *in vacuo* in the presence of sulphuric acid produces a temperature of 87° C. below zero; liquid nitrous oxide in becoming gas reduces the temperature to $-88°$ C.; solid carbonic acid produces a temperature of $-90°$ C., and when mixed with ether and placed *in vacuo*, of $-100°$ C., while the greatest artificial cold has been obtained by the rapid evaporation *in vacuo* of a mixture of liquid nitrous oxide with disulphide of carbon, when the temperature fell to $-140°$ C. By the employment of a freezing mixture of solid carbonic anhydride and ether, simultaneously with excessively high pressures, Andrews has reduced nitric oxide to 1·680th of its original volume, oxygen to 1·554th, and hydrogen to 1·500th, but in no instance did these gases exhibit signs of liquefaction. It is obvious that in the case of compressible matter pressure will tend equally with loss of molecular motion to lessen the molecular potential energy).

From the above paragraphs it follows that, when molecular motion is added to molecules, it performs two functions, for a portion of it is converted into work (*vide* Lecture I.) which confers potential energy upon the molecules by separating them (*expansion*), while another portion increases the temperature of the substance (*vide* Lecture II.), by conferring upon the molecules a larger quantity of the motion which constitutes heat, and hence increasing their velocity. Thus a portion of the added molecular motion disappears as heat, and this is still known as *Latent Heat*—(*Lateo*, to lie hid, because it was imagined by those who adopted the material theory of heat (*vide* Lecture I.)that the heat thus designated was somehow hidden in the substance, as in a cave, and that it only came out under certain conditions, and this idea was one of the most notable of the many *idola specus* possessed by the Materialists).

The quantity of heat which is thus expended in interior work when a solid passes into the liquid, or a liquid into the gaseous condition, can be readily determined. Thus, if a pound of boiling water (212° F.) be mixed with a pound of ice-cold water (32° F.) the temperature of the resulting two pounds of water is found to be 122° F., that is, the mean of the two:— $\frac{212° + 32°}{2}$ F. = 122° F. But if a pound of ice (32° F.) be mixed with a pound of boiling water, the temperature of the resulting two pounds of water is found to be only 51° F. Now it is obvious that the difference in the total heat of the two mixtures is that required to raise two pounds of water, 122° − 51° F. = 71° F., or one pound through 142° F. In other words, in the act of liquefying a pound of ice at 32° F., an amount of heat is consumed as internal work which is competent to raise one pound of water through 142° F.; that is to say, 142 units of heat (*vide* Lecture I.), which represents as mechanical work one pound weight raised to a height of 772 × 142 feet = 109,624 feet (or more than 20 miles) above the surface of the earth (*vide* Lecture I.)

The actual amount of molecular motion possessed by different substances (*specific heat*) varies considerably, for not only do the molecules in a given space vary in quantity, but also in weight, and in their attraction for each other; hence, also, the amount of heat consumed in internal work varies, because it depends upon the relative attraction of the molecules.

The amount of molecular motion necessary to raise any substance through a known number of thermometric degrees (*vide* Lecture II.) compared with that necessary to raise the same weight of water through the same number of of degrees, is called the specific heat of that substance. Thus, to raise 1lb. of water 1° F. in temperature requires thirty-three times the amount of heat necessary to raise one pound of mercury 1° F. in temperature; hence, the specific heat of water being represented by 1·00, that of mercury will be 0·033.

Conduction of Heat is the transference of molecular motion from molecules possessing a certain amount of it to molecules possessing less of it, by direct communication of motion. Those molecules which are apt to receive and transmit the motion are called *conductors* of heat, while those which are unfitted for the reception and transmission of the motion (whether from their slight mobility, or from an inaptitude to accommodate themthemselves to that kind of motion) are called *non-conductors* of heat.

Convection (from *conveho*, to carry up) is an action induced by external means—the force of gravity—in virtue of which a congeries of molecules of liquid or gas, possessing a greater amount of molecular motion than surrounding congeries or system of congeries, rises *en masse*, because the motion of heat, by increasing the distance between the molecules of matter (*vide* Lecture II.) causes a given number thereof to occupy a larger space when they possess a certain amount of that motion than when they possess relatively less, whence ensues a difference of density and a consequent difference of action on the part of gravity, for in equal bulks there are now no longer equal weights of matter, and one mass is now attracted by the earth more powerfully than the other.

UTILISATION OF BLAST FURNACE SLAG.*

In this paper the author endeavours to point out some of the uses to which this almost valueless material, which is produced in very large quantity in the manufacture of iron, may be applied. He states that slag is a compound containing an excess of lime, and produced by the siliceous and earthy matters contained in the ironstone, combining with the lime of the limestone used as a flux. Grey slag contains, in 100 parts :—Silica, 38·25; alumina, 22·19; lime, 31·56; magnesia, 4·14; protoxide of iron, 1·09; manganese, a trace; sulphide of calcium, 2·95; but the composition of slag differs according to a variety of circumstances.

The author then discusses the means of converting slag into paving stones, applying it to the manufacture of sulphate of alumina, aluminate of soda, and pure silica for

* Abstract of a paper read before the Cleveland Institution of Engineers, by Mr. Crossley.

the manufacture of porcelain, for most of which purposes patents have been taken out. He then proceeds to point out a plan of his own invention in which the slag, after being brought into a suitable state of subdivision, is treated with hydrochloric acid, whereby silica is obtained in a gelatinous form, and the alumina, lime, magnesia, and iron dissolved; the solution is evaporated to dryness, washed with water to dissolve out the soluble salts, the insoluble residue is treated with sulphuric acid, by which means sulphate of alumina is formed, the solution of which may be decanted off; the silica after washing with water is left in a pure state. The sulphate of alumina may either be evaporated to obtain that salt in the solid and dry state, or it may be used for the manufacture of alum. By this process slag will give a product worth £3 per ton and another worth £7 per ton. The author uses hydrochloric instead of sulphuric acid, as it is, in many instances, a waste product. Every 100 tons of slag will yield 33 tons of silica and 147 tons of sulphate of alumina.

PROCEEDINGS OF SOCIETIES.

QUEKETT MICROSCOPICAL CLUB.

THE fourth annual general meeting was held on Friday evening last, in the library of University College. Mr. ARTHUR E. DURHAM, President, in the chair.

A report was read, which showed that 142 members had been elected since the last annual meeting, making a total of 512. The Treasurer's report showed that the finances were in a very satisfactory condition.

In vacating the chair which he had filled for two years the President delivered a highly impressive address, which was listened to with marked attention throughout.

The following gentlemen were elected to fill the offices named for the ensuing year:—

President—Mr. P. Le Neve Foster.

Vice-Presidents—Dr. R. Braithwaite, Mr. W. M. Bywater, Mr. A. E. Durham, Mr. H. F. Hailes.

Members of Committee—Mr. T. Crooke, Mr. B. T. Lowne, Mr. S. J. McIntire, Dr. J. Matthews.

Treasurer—Mr. R. Hardwicke.

Hon. Secretary—Mr. T. Charters White.

Hon. Secretary for Foreign Correspondence—Mr. M. C. Cooke.

A paper "*On the Ratio-Micro Polariscope*," by Mr. James J. Field, its inventor, was read, at the conclusion of which the instrument was exhibited. Ten new members were elected, after which the proceedings terminated.

NOTICES OF BOOKS.

Qualitative Chemical Analysis. By Dr. C. REMIGIUS FRESENIUS, Director of the Chemical Laboratory at Wiesbaden. Seventh edition. Edited by ARTHUR VACHER. London: John Churchill and Sons, 1869.

MANY years ago when analytical chemistry was but little studied in this country, and the few who practised it used Rose's "Handbuch der Analytischen Chemie," Mr. Lloyd Bullock introduced a translation of the works of Dr. Fresenius on "Qualitative and Quantitative Analysis." These are so well known to chemists, and have become such thoroughly standard authorities, that it is almost unnecessary to notice a new edition.

The "Qualitative Analysis," unlike the Quantitative, has diminished rather than increased in bulk, and this arises from an increased condensation and an alteration in some respects of the arrangement of the work. "This edition," says Mr. Vacher in the preface, "differs greatly from the last. . . . The language has been condensed, the notation and nomenclature have been modernised, the arrangement has been simplified."

We are glad to notice the removal of the great mass of cross references, which formerly added so much to the already sufficient difficulties of the beginner, and which always reminded us of one of the more complex pages of "Bradshaw."

The work, as now arranged, is divided into the following sections:—1. Reagents, apparatus, and manipulation; 2. Reactions and separations; 3. General analysis; 4. Special analysis; 5. Reactions and separation of rare inorganic bodies; 6. Reactions and separation of organic bodies; 7. Detection of poisons in bodies, food, &c.; 8. Tables. The few tables which are given are eminently serviceable, and might, with advantage, be printed separately on calico for laboratory use. It is a grand mistake to print tables on paper which are to be used side by side with the test-tube rack, and to bind them up with a book; we all know how soon they become torn, and discoloured, and acid stained. Such tables, together with works on chemical manipulation, might with advantage be printed upon calico or vegetable parchment.

Every book which is meant for constant laboratory use should have a special binding, as durable as binding can be made, and, best of all, literal boards of thin oak. We have the misfortune to possess a copy of Regnault's "Cours de Chimie," bound elaborately in white vellum. An *edition de luxe* of a work on chemistry is a far more useless object than an *edition de luxe* of a treatise on the infinitesimal calculus, and may be classed with silver trowels, ivory croquet mallets, Louis Quatorze clocks, and other ornamental but useless—at least, unpractical—things. A certain great king, we are told, once presented a certain great chemist with a laboratory, in which every vessel was of platinum; this was a laboratory *de luxe*; give us good glass, say we, with a judicious sprinkling of the above precious metal, with homely porcelain and still homelier Stourbridge clay, and we will leave king's gifts to king's chemists, albeit a little Royal patronage would not be unserviceable to our science.

To return to our book; we may observe that the "Qualitative Analysis" of Fresenius is not so much in vogue as his "Quantitative Analysis," and this arises from the fact that there have arisen in our native chemical literature,—sparse though it be—various works on "Chemical Manipulation," and "Laboratory Practice;" again, many teachers adopt a special form of their own, based, perhaps, upon that of Fresenius, but differing in character and arrangement therefrom. Still it looks well to have a seventh edition of any work on chemistry in this country, and we wish Messrs. Bullock and Vacher further success. We would suggest in conclusion that the utterly inadequate index of *less than two pages* should at least be trebled in size in the next edition.

Dictionnaire de Chimie Pure et Appliquée. Par Ad. WURTZ. Paris: L. Hachette.

THE first *fascicule* of this work gives us some idea of its ultimate extent: although printed in somewhat small type, and in double columns, the 160 pages carry us only as far as Allyle. We shall review the whole work at length when it appears in its entirety, meanwhile, we propose rather to call attention to its general character than to give a review. M. Wurtz is assisted in his labours by no less than seventeen *collaborateurs*, among whom we notice the names of Debray, Emile Kopp, Lauth, and Naquet. The subject matter includes—Inorganic and Organic Chemistry; Chemistry applied to the Arts, Manufactures, and to Agriculture; Analytical Chemistry, and "La Chimie Physique et la Minéralogie."

We notice in this number an admirable article by M. Salet on "Affinity," terminated by a list of works relating to the subject which commences with the *Pyrosophia* of

Barchusen (1698). We almost think that such a list is incomplete without the *Physica Subterranea* of Beccher, the *Tractatus Quinque Medico Physici* of Mayow, and the *Fundamenta Chemiæ* of Stahl, but it must be allowed that the idea of affinity possessed by these men was excessively crude and indefinite. Perhaps Otto Tachenius may also be quoted as having a glimmer of the action of predisposing affinity. The article on "Air" by M. Le Blanc is unfortunately short, and does not make mention of the more recent researches on impure and vitiated air. M. Caventon supplies an article on "Alkaloids," and he herein furnishes a very complete list of these bodies, including some which can scarcely be called familiar; for instance, Chiococcine (*Chiococca racemosa*); Ménispermine (*Menispermum cocculus*); and Surinamine (*Geoffræa Surinamensis*). In a somewhat elaborate article on "Alcohols" by Kopp, a very good description (accompanied by woodcuts) is given of the various stills which are used in the process of manufacture, among them the ingenious *appareil Champonnois*. We shall return to this work on its completion; meanwhile, we have no doubt that it will be found in every chemical library.

CORRESPONDENCE.

OLEOGRAPHS.

To the Editor of the Chemical News.

Sir,—During some months past there have been sent to me various paragraphs from general and trade newspapers, prices current, penny magazines, &c., praising Dr. Moffat's oleographs as being valuable in the oil trade, to druggists, &c., and associating them with my name. I have this day seen a notice which states that Dr. Moffat's oleographs are based on the cohesion figures of Mr. Tomlinson, "published last year!"

In the Chemical News for the 11th December last, (vol. xviii., p. 284) I gave the history of my discovery, dating from 1861, and published in that year, and in your number for 29th January last (vol. xix., p. 59) I recorded my opinion of these oleographs. I stated that they are without distinctive characters, and are consequently valueless as oil tests.

Unless Dr. Moffat has wonderfully improved on the specimens he sent to me I do not understand how he can sanction, or, at any rate, allow to pass uncontradicted, the puffing paragraphs to which I refer. I have not the means or the inclination to get counter statements inserted in the journals referred to, but I do hope that after this second protest in your columns Dr. Moffat will use his influence to correct the misapprehension which must arise from such paragraphs.

The cohesion figures of liquids are in themselves oil-tests; but when transferred to paper, as in these oleographs, the resemblance between the figure of one oil and that of another is so close that they may be taken as identical, and they are, therefore, for practical purposes, useless, as friends of mine connected with the oil trade have proved.

While heartily wishing success to oleography, I cannot see much prospect of it in the present state of the art, and I am sure that Dr. Moffat would not wish to describe as a finished picture that which is only a rough, and by no means correct sketch.—I am, &c.,

C. Tomlinson.

Highgate, N., July 26th, 1869.

GASEOUS SPECTRA.

To the Editor of the Chemical News.

Sir,—Our attention has been drawn to a letter from Mr. W. Huggins, in your impression of the 9th instant, stating that, in a recent note to the Royal Society (in which we announced that, by varying the conditions of pressure and temperature, we had reduced the spectrum of hydrogen, as seen in our instrument, to one line absolutely, and the spectrum of nitrogen to one line nearly), we did not notice similar observations of his own presented to the Royal Society in 1868. In reply, we beg to state—First, that we did notice Mr. Huggins's observations, and, secondly, that they were not similar to our own.

With regard to the first point. The account you were good enough to publish contained the following:—"The bearing of these latter observations on those made on the nebulæ by Mr. Huggins, Father Secchi, and Lord Rosse is at once obvious. The visibility of a single line of nitrogen has been taken by Mr. Huggins to indicate possibly—First, 'a form of matter more elementary than nitrogen, and which our analysis has not yet enabled us to detect;' and then, secondly, 'a power of extinction existing in cosmical space.'

"Our experiments on the gases themselves show not only that such assumptions are unnecessary, but that spectrum analysis here presents us with a means of largely increasing our knowledge of the physical constitution of these heavenly bodies."

We thus gave briefly the results of Mr. Huggins's enquiries, and references to where a complete account of his observations were to be found. This we considered to be sufficient, seeing that our communication was a preliminary note only. In the complete account of our researches to be subsequently presented to the Royal Society we shall, of course, dwell upon them at greater length.

With regard to the second point—the similarity of the observations. In 1864, Mr. Huggins first observed the spectrum of the nebulæ, and determined that one of the lines was coincident with one of the air lines due to nitrogen, the spark being taken close to the spectroscope. On this Mr. Huggins wrote:—"The speculation presents itself, whether the occurrence of this one line only in the nebulæ may not indicate a form of matter more elementary than nitrogen, and which our analysis has not yet enabled us to detect." Some time afterwards, Mr. Huggins, instead of taking the air spark close to the spectroscope, placed it outside the object glass of his telescope, and then only saw one line in the spectrum—the line in question. He next got similar results close to the spark by interposing a dark glass to cut off the light, still using the spark in air at the ordinary pressure, and remarked that it was "obvious" that the hydrogen spectrum would give similar results. Then, after stating "we cannot suppose that any lines have been extinguished by the effect of the *distance* of these objects from us," he refers to the possibility of a "power of extinction residing in cosmical space," and the hypothesis of the more simple form of nitrogen appears to be given up.

Now, with regard to our own observations, we have *not* taken the spark in air; we have *not* used a dark glass; we have *not* worked at atmospheric pressure; nor have we disturbed the normal distance of the experimental tube from the slit of our instrument until we had reduced the complicated spectrum of nitrogen to one bright line and three or four other extremely faint ones. Further, we have *not* rested content with any assumption with regard to hydrogen, nor have we regarded anything as obvious.

What we have done is to carefully watch both spectra changing as the pressure becomes less, trying the effect of increased and decreased temperature at every stage under various conditions, which we shall state in our detailed paper.

It may be as well to refer, in conclusion, to Plücker's important work on nitrogen, which shows that, under certain conditions, the green line of nitrogen vanishes altogether from the spectrum. This fact alone shows at once the importance of our method of inquiry.—We are, &c.,

E. Frankland.
J. Norman Lockyer.

Royal College of Chemistry, Oxford Street, July 23, 1869.

MISCELLANEOUS.

Preservation of Protosulphate of Iron.—M. Welborn states that proto-sulphate of iron is absolutely preserved and kept from even the very least trace of oxidation, by placing with it a piece of camphor wrapped in a piece of clean and dry paper.—*Deutsche Ind. Zeitung.*

Preservation of Meat.—M. Georges recommends to place the meat into a bath containing 86 parts of water, 10 parts of common salt, 4 parts of glyceric acid or *acide vineux*, (glyceric acid is prepared by the author by mixing equal parts of glycerine, water, and hydrochloric acid; *acide vineux* is made in the same way, but instead of glycerine alcohol is added); after this fluid has become thoroughly soaked into the meat it is pressed and squeezed, and next covered with a layer of fat.—*Deutsche Ind. Zeitung.*

Action of Carbolic Acid on Reptiles.—We have been favoured with extracts from an account of some very valuable experiments made by J. Fayrer, F.R.S.E., C.S.I., &c., on the value of carbolic acid in preventing the entry of serpents into dwellings, from which we find that a few drops of the acid are sufficient to quickly kill full-grown cobras and other poisonous snakes. Dr. Fayrer is continuing his experiments on the merits of carbolic acid as a therapeutic agent in snake bite, and, in the meantime, he suggests its use as a preventive against the entry of snakes into houses, &c. Dr. Calvert informs us that it is probable that the acid will save life by applying it, in a caustic state, to the wound caused by the bite of a serpent, and more satisfactory results will be obtained by following the method first put into practice by Dr. Tessier in the Mauritius, for the cure of a virulent intermittent fever. In this case, by injecting under the skin a solution of three-quarters of a grain of carbolic acid dissolved in 20 minims of water, the patients were rapidly cured, and the spread of the pestilence arrested.

Experiments with Flame.—Dr. Hofmann, F.R.S.—Take a piece of canvas, such as is used by ladies for Berlin wool work, and put it on to the top of the superior opening of the glass chimney of an argand gas burner, taking care to envelope the glass chimney previously with a very thin piece of copper foil, while the access of air at the bottom of the burner should be as much as possible prevented. On turning the gas on, it escapes readily through the small openings in the canvas, and the gas may be ignited above. The canvas, however, soon takes fire and burns off, but leaves a very complete circular disc, which remains white and unconsumed in the centre of the frame. If it is desired to demonstrate more completely the nature of the flame, it is done by placing, on the middle of the canvas disc, some gunpowder, and on it the heads of some lucifer matches. After having again turned on the gas, and left it to escape for a few moments, it may be kindled again, and will burn quietly, and even though, as in the first experiment, the excess of canvas again burns off, neither the gunpowder nor matches will catch fire until just at the moment the gas is gently turned off. In order to exhibit the reducing action of the interior portion of a Bunsen gas flame, a spirally rolled-up piece of copper wire is held in the interior portion of the flame by means of a pair of forceps. When this spiral is taken out of the flame while red-hot, and exposed to contact of air, it becomes covered with a black coating of oxide of copper; but if the spiral, instead of being taken out of the central portion of the flame is lowered down into the current of gas, and there cooled, it will exhibit on, withdrawal, a clean and bright metallic surface.—*Berichte der Deuts. Chem. Ges. zu Berlin.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Programme de la Société Hollandaise des Sciences de Harlem, Année, 1869.

On the 15th of May, the general yearly meeting of this scientific society was held at Harlem. The meeting approved of the proposal made by a committee, to found two additional medals, each of the intrinsic value of 500 florins (about £42), one of which will bear the name and effigy of Huyghens, the other that of Boerhaave. These medals are intended to be given, every alternate two years, to those scientific men, native or foreign, who, by their researches, discoveries, or inventions, shall, according to the opinion of the Society, have most contributed, during the last twenty years, to the advancement of a specific branch of physico-mathematical, or natural history sciences. The Huyghens medal will be awarded, in 1870, to natural philosophy; in 1874, to chemistry; in 1878, to astronomy; in 1882, to meteorology; and in 1886, to mathematics (pure and applied). The Boerhaave medal will be awarded, in 1872, to mineralogy and geology; in 1876, to botany; in 1880, to zoology; in 1884, to physiology; and in 1888, to anthropology. The preliminary award shall be made according to the advice of a committee to be appointed by the directors of the Society, of which committee the secretary of the Society shall be a permanent member. The final award shall be made at the general yearly meeting of the Society, after it shall have discussed the report and heard the full explanation given by the committee just alluded to.

Among the questions open for competition, and to be answered on or before the first of January, 1871, we notice the following:—

The Society asks for an accurate description of all chemical or physical operations, whereby either accidentally, or as a consequence of direct experiments, chemical compounds have been obtained, which, by their chemical and physical properties, agree with native minerals. The Society does not desire that new minerals should be artificially formed, but simply an accurate and critical review of the results already obtained; while it is also requested that all the published and printed memoirs wherein such artificially-made minerals have been described shall be fully mentioned.

The Society desires a monograph on albuminous substances; this work to include an historical sketch of all the researches made concerning these substances, and a critical review of the divers opinions which, at the present day, are current in science in reference to these materials.

The Society desires that the co-efficients of expansion, by heat, of divers kinds of glass, and more especially the glass used for making thermometer tubes, be very accurately determined, according to M. Fizeau's method, for temperatures according to the centigrade scale, from −30° downwards to 500° upwards.

Since more recent researches appear to confirm the opinion that the substances known as hydrates of carbon are polyatomic alcohols, the Society desires that new researches be made in order to clear up and fully elucidate this point.

Since the accurate determination of temperatures above 350° is a matter open to great improvement, the Society has decided to grant its gold medal to him who shall succeed in the construction of a simple apparatus whereby temperatures up to 500° are correctly indicated.

The Society asks accurate determinations of the various indices of refraction of water, for at least 12 points of the spectrum, over a range of 50°.

It is well known that the Aurora Borealis causes telluric electric currents, which occasionally disturb the proper action of the electric telegraph wires; the Society desires that, on telegraphic lines of great length, the force of these currents be determined, and that it be also ascertained how far these currents extend towards the equator.

The two questions which the Society desires to receive replies upon, on or before the 1st of January, 1873 (both bearing upon natural history), we need not quote, but specially notice the following questions to which answers are expected on or before the 1st of January next, these questions having been propounded and published last year:—

Since it cannot be denied that spectrum analysis, now almost the order of the day, has been overrated, and its value exaggerated, it is desired that, in order, also, to obtain more sound views on this matter, that which is true and that which is false therein be equitably sifted; that the limits be stated up to which this method is of legitimate use, and beyond which it fails to be applicable; and, lastly, that a critical review be made of all facts brought to light by this branch of experimental research, and, also, that it be pointed out what science has to expect of its extended application.

The electric current heats the metallic conductor which is traversed by it; hence the resistance the current experiences is increased, and in this manner the current reacts on itself. We may, on the other hand, suppose that the intensity of the current modifies the value of this resistance by virtue of an action which does not directly depend upon the heating. It is desired that the influence exercised by the intensity of the electric current on the degree of resistance be investigated in both points of view just mentioned. Among the metals which seem to offer the best chance of success for this kind of investigation, mercury holds a prominent place.

The repetition, extension, and criticism is asked of the experiments concerning the electrolysis of the fused haloid salts (Faraday's "Experimental Researches," T.I., art. 538 and following, and 978 and following); also an *exposé* of the theories of the nature of electrolysis which can be deduced therefrom. Faraday's law of electrolysis is very simple; but the question is not yet exhausted, and the whole phenomenon is obscure. It is therefore desired that it should be rigorously decided up to which point the above-mentioned experiments are in opposition with this higher view, and aided by a great many facts, according to which no real electrolysis whatever should take place unless the action of the current be only exerted upon double salts, or upon combinations equivalent and analogous therewith.

According to M. G. Ville (see his *Revue des Cours Scientifiques*, 1868, No. 7, p. 103), nitrogen, in its free or elementary state should be assimilated by some kinds of plants, especially those belonging to the *Leguminosæ*; the Society therefore asks that this opinion be submitted to a critical examination, and that the truth or falsity of this opinion be fully made out on theoretical as well as on experimental ground.

In reference to the extremely interesting and highly-valued experiments of Mr. Graham, Master of the Mint, the Society asks for new researches on the absorbing and dissolving power of molten metals for hydrogen gas, especially with the view to determine whether there

do exist definite combinations of hydrogen and metals. The Society desires to have experiments made with various metals, in order to ascertain, with certainty, the fact whether the assertion that metals become transparent at a sufficiently high temperature holds good, or is to be rejected.

Since there yet exists a great deal of uncertainty on the subject of the cause of the phosphorescence of substances called artificial phosphori, the Society requests that a thorough research be made to establish the fact that this phosphorescence is only due to a slow oxidation.

Whilst the pressure of the air, the direction and force of the wind, and the temperature of the air are continuously recorded at the meteorological observatories, by means of self-acting and self-registering instruments, the degree of moisture of the air is as yet only recorded by a few isolated observations made at certain hours of the day-time. The Society desires the construction, either upon an entirely new plan, or according to the principles indicated (see *Poggendorff's Annalen*, vol. xciii., p. 343), of a self-acting or self-registering instrument for determining the degree of moisture of the air, and the publishing of results of observations obtained by means of such instrument for at least one half-year continuously.

The Society desires to recommend, to the competitors for prizes, to omit, in their answers to questions, any matters not directly relating to the proposed question; it is, moreover, desired that, whatever be sent into the Society should be worked out with precision, and that every proposition be well defined and demonstrated, and not mixed with vague theories or badly digested and not well established facts. The memoirs sent in must on no account whatever be written in the handwriting of the authors themselves, since, if even these memoirs might be worthy of the award of the medal, and it turned out that such documents were written in the author's own handwriting, no award whatever could be made, according to the Society's rules. The envelopes added to the memoirs sent in, and appended thereto by a peculiar mark, and containing the author's name, will, in case no award is granted, be destroyed by fire, unopened. The memoirs to be sent in for competition may be written in Dutch, French, Latin, English, Italian, or German languages, at the author's option, provided, in the case of the German language, the italic, and not the peculiar German mode of writing, be used. All such documents, and the envelopes appended thereto, and just alluded to, should be sent, carriage or postage paid, to Dr. E. H. von Baumhauer, the Secretary of the Society, residing at Harlem, North Holland, Netherlands.

The prize offered for a satisfactory memoir, or answer, to each of the proposed questions, is the Society's gold medal, value 150 florins (£12 10s.), bearing the author's name and the year of issue, or, if the author might desire it, the full money value of the medal; in some cases, it is left to the umpires of the awards to grant an additional award of 150 florins. The competitor to whose memoir a prize shall have been awarded may not, without the express consent and authorisation of the Society, print or publish, either in whole or part, separately or in any periodical, the memoir to which the prize has been awarded.

Polytechnisches Journal von Dingler, vol. cxcii., No. 5, first part for June, 1869.

We notice the following original papers and communications in this number:—

Researches made in the Laboratory for Technical Chemistry at Brunswick.

a. **Abnormal Behaviour of Saccharate of Lime.**—M. Waldeck. It is a well-known fact that the combination of lime and sugar yields, with cold water, a clear solution, which, on being heated, becomes turbid, or even gelatinises. A solution having been prepared, by mixing, with a solution of pure sugar in water, an excess of slaked lime, shaking this mixture, and afterwards filtering it; on heating this solution, no turbidity ensued at all. This phenomenon gave, of course, rise to further investigation, when it was found that the lime which had been applied in this instance was chemically pure hydrate of lime. On mixing some of the same sugar solution with lime as ordinarily obtained from lime-kilns, it was found to exhibit again the phenomenon of becoming turbid on heating. At first sight, therefore, it would appear as if chemically pure lime behaved differently with sugar solution from what ordinary lime does; but further investigation into this matter brought to light the fact that, owing to the necessity of obtaining a fresh supply of sugar, this substance, and not the lime, was the cause of this discrepancy. The author found that, although at first sight no difference could be detected in the refined sugars applied, yet the last-obtained sample behaved, both with the chemically pure and ordinary lime, in the same manner, yielding a solution which becomes turbid on heating; both kinds of sugar were refined white loaf sugar obtained from the same place and at the same price. Of the first sample, yielding abnormal results, unfortunately no more was obtainable, and therefore the matter remains in some obscurity; but those who are connected with sugar refineries might take this hint, and, perhaps find a valuable means of distinguishing between various samples of refined sugar.

b. **Manufacture of Soda from Sulphate of Soda and Oxide of Iron.**—M. Waldeck.—The author points out that the manufacture of soda from its sulphate, and by the intermedium of carbon (charcoal or small coal) and oxide of iron, would be, in many aspects, a great improvement upon the Leblanc process. He next mentions some experiments to illustrate his views on this subject. He took 105 parts, by weight (three atoms), of sulphate of soda; 40 parts, by weight (1 atom), of peroxide of iron; and 25 parts, by weight (eight atoms) of carbon. This mixture fused readily; treated with water, it yielded a solution which, on passing therein a current of carbonic acid gas, became quite clear, leaving only 2·79 per cent of insoluble residue. However fair the results these experiments gave on the small scale, the author is himself unable to solve a difficulty which, on the large scale, would be an absolute impediment to the action; to wit, that neither cast nor wrought-iron vessels—and, worse yet, no fire-clay crucibles, or furnaces built with fire-bricks—will stand the action which is called into play, leaving out of the question the necessity of absolute exclusion of air during the fusion.

On a Dolomitic Marl, and its Use in the Making of Cement. L. Gatschenberger.—In the neighbourhood of Heidelberg, a marl occurs which, after being prepared for that purpose, yields a cement of the following composition, in 100 parts:—Lime, 44·22; magnesia, 17·77; peroxide of iron, 3·07; alumina, 5·75; protoxide of manganese, 2·33; soda and potassa, 4·72; silica, 22·14. The author had the opportunity of experimenting with the marl itself; and he states—"I find there are two different modes of obtaining from this marl an excellent hydraulic lime—1st, to burn the marl at a temperature below 400°, whereby the magnesia only loses its carbonic acid, while that from the lime is not expelled; 2nd, to burn the marl at a very elevated temperature, whereby the material is even somewhat fluxed. In the first instance, the magnesia is the active matter, since I have found that it hardens under water with carbonate of lime perfectly well, but not with caustic lime. In the second instance, the magnesia loses, indeed, its hydraulic properties, but, instead thereof, its activity towards silica is so increased as to behave therewith as lime does in such cases. The author finds that the cement obtained by the application of the very high temperature, is preferable to the ordinarily-obtained hydraulic cements. A very good cement made at high temperature contains, for 100 parts of SiO_2,R_2O_3, 304 parts CaO,MgO, whereby the proportion between lime and magnesia is as 2 to 1.

On Alkanin.—Prof. Boettger.—The author states that M. Hirzel, at Leipzig, prepares alkanin, the extract of the alkanet root *anchusa tinctoria*, on the large scale. This extract is dissolved in absolute alcohol; and with this solution strips of Swedish filtering paper are saturated, and made use of, after drying, for detecting even the very faintest traces of ammonia. The alcoholic solution exhibits a beautiful red colour, which, even by the ammonia present in tobacco-smoke, or in illuminating gas, is instantly converted into a beautiful blue. The alcoholic solution and the test-paper have, of course, to be kept carefully excluded from all ammoniacal fumes. The red paper may be turned into blue by a very weak aqueous solution of carbonate of soda, and it then becomes an excellent test for even the faintest trace of any acid, turning red therewith at once.

Preparation of Pure Oxygen Gas at the Ordinary Temperature.—Prof. Bœttger.—The author says that, when a mixture is made of equal parts, by weight, of peroxide of lead and peroxide of barium, and there is poured on this mixture dilute nitric acid of a strength of 9° Beaumé, and specific gravity 1·067, a current of pure oxygen, free from ozone and antozone, is given off abundantly. The mixture of the two peroxides alluded to may be kept together in a stoppered bottle in dry state for any length of time.

Analysis of Palm-Nut Meal and Palm-Nut Cake.—Prof. Hohmann.—Palm-nut meal contains, in 100 parts—Water, 8·55; albumen, 19·56; fatty matters, 1·19; starch, 47·73 woody-fibre, 20·04; ash, 2·93. Palm-nut cake contains, in 100 parts—Water, 10·0; albumen, 15·1; fatty matters, 15·9; starch, 41·0; woody-fibre and ash, 18·0. These substances are obtained from the *Elaïs equienensis*, and used as fodder for cattle.

Vol. cxcii., No. 6, second number for June, 1869.

This periodical contains the following papers bearing upon chemistry, and sciences intimately allied thereto:—

Coating of Glass, Porcelain, or Earthenware with a Thin Film of Lustrous Metallic Platinum.—Prof. Bœttger.—Dry chloride of platinum, freed from excess of acid, is mixed, in a small porcelain mortar, with essential oil of rosemarine (*Oleum anthos*) until the original brown-red colour of the salt has entirely disappeared, and has been converted into a black, pitch-like looking mass. In order to effect this result, it will be necessary to renew the essential oil at least three times. When the pitch-like mass has been obtained, the oil is entirely removed, and the pasty mass is weighed, and afterwards mixed with at least five times its weight of lavender oil, and mixed therewith to a homogeneous fluid; this, after having been quietly standing for half-an-hour, is applied with a hair brush on the glass or porcelain objects to which it is desired to give a coating of lustrous platinum; and, after the very thinly and evenly laid on film is dry, the objects are either placed in a red-hot muffle, or heated in the flame of a glassblower's lamp, care being taken not to exceed a red heat.

Black Patina upon Zinc.—M. Neumann.—The author has instituted a series of researches to find out the best and most suitable material to produce upon zinc—or rather upon statuary and ornamental objects made of that metal—a pleasing blackish coating, without the necessity of impairing the effect of the natural colour of the metal, as would be the case when an oil-paint or varnish is used. The best results were obtained by the author when nitrate of protoxide of manganese was used: this salt, on being heated, is decomposed, yielding black peroxide of manganese, and the degree of heat required is not so high as to affect the zinc. To 1 litre of pure water, 54 grammes of the nitrate alluded to, and containing six equivalents of water of crystallisation, is, according to the author, the best solution for this purpose; and the specific gravity of that solution, at 14° R., is stated by the author to be 1·125.

Saponification of Fats when in the state of Emulsion.—M. Waldeck.—This paper confirms the results formerly obtained by M Mège-Mouriès. The author of this memoir points out that

forming an emulsion of fats by means of substances such as gum, for instance, would be impracticable for the manufacture of soap, entailing, as it would do, loss of lye as well as of the gum or other similar substance; he, therefore, in consequence of the results obtained by him in experiments expressly instituted, advises the use of alkaline lye for the purpose of forming emulsion; but, if that plan be resorted to for soap-making purposes, the use of distilled water is an absolute requisite, but, of course, no impediment at all, since, where steam is used, distilled water is readily enough obtainable. The emulsed fats are very rapidly and readily saponified.

Portuguese Graphite.—M. Knublauch.—In 100 parts, this material was found to contain—Water (hygroscopic as well as of combination), 10·21; carbon, 38·47; ash, 50·81.

Consumption of Divers Materials used as Substances for the Production of Artificial Light.—Dr. Willigk.—This paper, although very interesting, is too lengthy to admit of useful abstraction.

On a So-Called Disinfecting Soap.—Dr. Pincus.—The author very properly calls attention to an error committed by a chemist and a soap manufacturer, who state that they have succeeded in obtaining a soap which contains permanganate of potassa as an active and disinfecting ingredient. On investigation by the author, he found, as might be expected, that even the freshly made soap only contained oxide of manganese, and a mere trace of permanganate. This latter salt, of course, cannot be kept for any length of time in contact with an organic material, as soap is, without becoming decomposed. The soap was made by incorporating into well-made, hard soap, quite dry, and cut into shreds, powdered permanganate, and then forming this mixture into a cake by strong pressure.

Annales du Génie Civil, No. 6, June, 1869.

This periodical contains a lengthy paper—

On Wine.—M. Boucherie.—Composition of must and of wine the former contains—Sugar, a nitrogenous principle which is fit for; fermentation, ferment, or active yeast, a colouring matter contained in the skin of the grape, but, as yet, not dissolved in the liquid, and oxygen and nitrogen. Wine contains carbonic acid, a small quantity of grape sugar alcohol, amylic alcohol ($C_{10}H_{12}O_2$), butylic alcohol ($C_8H_{10}O_2$), propylic alcohol ($C_6H_8O_4$), campholic alcohol ($C_{20}H_{18}O_2$), several essential oils (the nature of which is not precisely known), oenanthic ether, aldehyde, valeric acid, acetic acid, butyric acid, glycerine, and the colouring matter of the skin of the grapes dissolved in the alcohol formed by the fermentation. Wine and must, moreover, constantly contain water, organic non-crystallisable matter, gum-like substances (as pectin and dextrin), mannite, and nitrogenous substances; and also the following crystallisable organic acids:—Tartaric, racemic, tannic, malic, pectic, and citric. No *free* mineral acids. The following salts of organic acids and inorganic bases:—Bitartrate of potassa, tartrate of lime, tartrate of alumina, malate of potassa, malate of lime, pectate of potassa, pectate of lime; divers acetates, further nitrates, phosphates, sulphates, silicates of the above-named bases, and also chlorides, iodides, bromides, and fluorides of these bases; while wine contains infinitesimal doses of soda, oxide of iron, alumina, oxide of manganese, magnesia, and ammonia. The quantity of alcohol naturally present in 100 parts of wine varies very considerably, and varies according to the locality where it is grown, the climate during the time when it was grown, and the variety of grape from which it is obtained. For red Bordeaux wines of average good quality, the quantity of alcohol varies from 8·10 to 10·85 per cent (the author does not state whether he means by bulk or by weight). For white Bordeaux wines, it varies from 9·25 to 15 per cent on average good wine and divers brands. For Burgundy wines (red variety), the quantity of alcohol varies from 10·10 to 13·09 per cent; white variety from 12·22 to 14·90. Good Roussillon contains about from 16·20 to 17·25 per cent of natural alcohol. White hermitage wine contains, on an average, 16·0 per cent of alcohol. Effervescing champagne contains 11·20 per cent of alcohol, while genuine port wine contains naturally from 22·50 to 23 per cent of alcohol, and marsala as much as 25·09 per cent. This alcohol, be it understood, is absolute and anhydrous.

The other papers of this periodical are devoted, as might be surmised from the title, to matters quite foreign to the subject just briefly abstracted, and of no direct interest to our readers.

Zeitschrift fur Chemie, von Beilstein, No. 11, June 26, 1869.

This periodical contains the following original papers:—

Synthesis of Crotonic Acid.—M. Stacewicz.—The author says—My starting point is taken from the well-known constitution of the acrylic acid series, and this made me expect to succeed in synthetically preparing crotonic acid, according to the scheme expressed in the following formulæ—

$$\left.\begin{matrix}C_2H_2\\H\end{matrix}\right\}ClO + C_2H_4Cl + 2Ag = C_2H_2(C_2H_3)\left.\begin{matrix}O\\H\end{matrix}\right\}O + AgCl.$$

The experiment was crowned with success, but the acid obtained differs from that prepared from cyanide of allyl. The mixture of chloracetic acid, chloraceten, and silver is heated, in a sealed tube, up to 140°, and, after the end of the reaction, the contents of the tube are submitted to fractional distillation. At 127°, an oily fluid is obtained, soluble in water, exhibiting a feebly aromatic smell; this fluid reddens blue litmus paper, and acts, when in contact with the skin of the human body, as a blistering agent. The silver-salt of this acid, $C_4H_3AgO_2$, is difficultly soluble in water, and crystallises in dendritic groups; the formula for crotonic acid is, therefore—

$$C\left\{\begin{matrix}H\\CH_3.CH_2\\O\\OH\end{matrix}\right.$$

On Chlorinated Toluidine, and a New Mode of Preparation of Bromobenzoic Acid.—M. Wroblevsky.—Chlorinated toluidine is prepared by passing through acetotoluid, $(C_2H_3O)HN.C_7H_7$, chlorine gas, whereby chloracetotoluid is obtained, which is purified by repeated re-crystallisation from its solution in water. This substance, which is composed according to the formula—

$$C_6H_3Cl.(CH_3).NH(C_2H_3O),$$

crystallises in large foliated crystals, fuses at 99°, is readily soluble in alcohol, less so in water; on being boiled with an alcoholic caustic potassa solution, acetic acid is formed, and chlorotoluidine—

$$C_6H_3Cl(CH_3)NH_2.$$

It is a colourless fluid, boils at 222°, is soluble in alcohol, but almost insoluble in water. From ortho-bromotoluol, a colourless liquid, which boils at 182°, the author prepared, by treating it with bichromate of potassa and sulphuric acid, ortho-bromobenzoic acid; this is a solid substance, which fuses at 153°, and then sublimes in long needle-shaped crystals, identical with those of the same compounds as obtained from benzoic acid.

On Sulphate of Lime and Potassa.—M. H. Struve.—This double salt was first discovered by M. Phillips, in the year 1850. The author of this paper says—When crystals of sulphate of lime are put into a saturated solution of sulphate of potassa at 12° (the specific gravity of that solution being 1·0716, and containing 9·41 per cent of the anhydrous sulphate of potassa), the crystals of sulphate of lime are soon converted into somewhat bulky pseudomorphic crystals of the double salt of sulphate of lime and potassa. When the solution of sulphate of potassa is more dilute, the change takes place more slowly; and when, in 100 c.c. of water, only 2·365 grms. of sulphate of potassa are dissolved, the sulphate of lime is simply dissolved therein without forming a double salt; burnt gypsum and native anhydrite behave in the same manner. The formation of similar double-salts takes place, but more slowly, when sulphate of lime is put into concentrated solutions of the chloride, bromide, and iodide of potassium; the same takes place with solution of nitrate of potassa.

New Mode of Formation of Anhydrite.—M. Struve.—100 parts of sulphuric acid (sp. gr. 1·82) dissolve, at ordinary temperature, 1·992 parts of artificial anhydrite (anhydrous sulphate of lime) and 1·953 parts of native anhydrite. When, to a quantity of 4 grms. of crystallised gypsum, were added 135 grms. of the same sulphuric acid, a solution was obtained which contains, for 100 parts of acid, 1·059 parts of $CaOSO_3$. When the solution of $CaOSO_3$ in SO_3HO is diluted with its own weight of water, a complete precipitation of gypsum took place after a time; no lime could be detected in the filtrate.

Preliminary Notices.—M. Wislicenus.—This paper treats briefly—

On Sulphaceton, and on the Conversion of β Oxybutyric Acid into Crotonic Acid.—As, however, the author states that his researches are as yet incomplete, and will be treated more fully hereafter, we abstain at present from further notice of them.

Researches on Piperinic Acid.—MM. Fittig and Mielck.—This is a lengthy memoir, chiefly treating on the products of oxidation of piperinic acid, which, when acted upon by permanganate of potassa in aqueous solution, yields a crystalline substance (formula, $C_8H_6O_4$), which body the authors called *piperonal*. It is difficultly soluble in cold water, more readily in boiling water, and very soluble in alcohol; it is in every way soluble in the latter fluid and in ether at the boiling temperature of these fluids. Piperonal fuses at 37°, and boils, without decomposition, at 263°. Piperonylic acid, $C_8H_6O_4$, is obtained in small quantity, simultaneously with the last-named substance, during the action of permanganate of potassa; moreover, piperonylic acid is readily obtained from piperonal by the action of permanganate. The acid just alluded to is a solid substance, crystalline, soluble in water and alcohol, fusing at 227·5°, subliming already below its point of fusion; it is a monobasic acid. Nitric acid acts most energetically upon piperinic acid, even when the former is dilute; the result of this reaction is the formation of an amorphous reddish-coloured substance, which baffled the efforts of the authors in obtaining reliable analytical results. After having, at great length, described the bromine reaction upon piperinic acid, the authors state that their researches are not as yet sufficiently complete to enable them to speak with confidence about some of their results.

Synthesis of Acids Homologous with Cinnamic Acid.—MM. Fittig and Bieber.—According to M. Bertagni's statement, cinnamic acid is formed when oil of bitter almonds is heated with chloride of acetyl; relying on this fully borne out statement the authors thought that when, instead of acetylchloride, homologous chlorides were taken, homologues of cinnamic acid would be formed; this idea has been experimentally tested, and the authors met with correct results; when equal equivalents of oil of bitter almonds and butyryl chloride are mixed and heated in sealed tubes, first to 100°, the reaction takes place, but only slowly; at from 130° to 140°, the reaction is more rapid, but yet takes several days for its completion; an acid was obtained of the formula, $C_{11}H_{12}O_2$, which the authors have named phenylangelic acid, because it stands in the same relation to cinnamic acid as angelic acid stands to acrylic acid; the quantity of acid obtained in this reaction is very small, the greater portion of the oil of bitter almonds being converted into a blackish resin, insoluble in solution of carbonate of soda.

On Ethyl-Phenol.—MM. Fittig and Kiesow.—Ethylphenol is prepared in pure state from ethyl benzol sulphate of potassium, which is

submitted to distillation at from 270° to 280° after having been mixed with thrice its weight of hydrate of potassa; the purification of the raw product thus obtained is a slow and tedious process; at length a solid substance, partaking of a regular crystalline form and fusing at about 48° is obtained; this body is the ethyl-phenol—

$$C_8H_{10}O = C_6H_4 \begin{cases} C_2H_5 \\ HO \end{cases}$$

it boils at 210°, but volatilises even at ordinary temperature.

On Amido-Benzoic and Nitrophtalic Acids.—M. Faust.—When nitrophtalic acid is reduced by means of tin and hydrochloric acid, amido-benzoic acid is formed, which is in every respect identical with amido-benzoic acid obtained by other means; it is a crystalline solid, containing, in 100 parts, C, 61·3; H, 5·1; O, 34·6. The author says he desires to rectify a statement made in a former number of this periodical, wherein he described as an ether what has afterwards been ascertained to be nitrophtalic acid—$C_8H_5(NO_4)O_4.C_8H_8.H$.

Conversion of Aldehyde into Aceton.—M. Schloemilch.—The author states, as a preliminary notice, *pour prendre date*, "I have succeeded in doing what is indicated under this heading, but am as yet occupied with further researches on this subject." This observation also extends to the contents of the brief notices of the following subjects:—

On Lepides and Oxylepides.—M. Limpricht.

On the Bromo-Substitution Products of Dibenzyl.—Same author.

Synthesis of Anhydrous Lactic Acid.—Dr. Von der Brüggen.—The author says, when anhydrous lactic acid is considered as being an ether, it follows that it must be possible to obtain this acid by the action of bromo-propionic acid on lactate of potassa; this, the author states he has actually carried out experimentally. His paper, however interesting, is so filled with formulæ, exhibited somewhat in the style of genealogical tables, that it would take up more room than we can afford, and therefore content ourselves with announcing in this brief notice the scientific *fait accompli*.

Preparation of Oxalate of Acetonin.—M. E. Mulder.—Aceton is added to sulpho-carbaminate of ammonium; the crude sulpho-carbaminate of acetonin thus obtained is washed with alcohol of 90 per cent, next dissolved in water, precipitated by means of perchloride of mercury, filtered; H_2S is passed through the filtrate; the latter is evaporated to dryness on a water-bath, the residue treated with absolute alcohol (which leaves $ClNH_4$ undissolved, and keeps hydrochlorate of acetonin in solution): water is next added, then again evaporated to dryness, the residue treated with $C_2O_4Ag_2$ in excess, filtered, the filtrate again evaporated to dryness, and afterwards exhausted with absolute alcohol until nothing more is dissolved; the oxalate of acetonin deposits from the solution and is purified by re-crystallisation; it exhibits a beautifully crystalline mass. Formula—

$$C_2O_2.C_9H_{20}N_2O_2 + 2H_2O.$$

The following are only preliminary notices on the respective subjects, of which more full research is going on:—

Kreatin and Aldehyde.—MM. Mulder and Moutheran.

Action of Bromine on Butyrate and Valerianate of Silver.—M. Borodin.

Isomers of Valerianic Acid.—Dr. Schneider.—The remainder and smallest portion of this number is, as usual, devoted to abstracts from divers papers, *Comptes Rendus*, &c., which are chiefly of last year's date, and already noticed by us.

No. 12, June 30, 1869.

This number does not contain any original papers at all, but we find in it some communications taken from a paper or periodical published in Switzerland, but, as stated, only printed for private circulation among the members of a society for the diffusion of useful knowledge, established at Zürich. The first of these papers is on the

Solutions of Iodine in Water and Aqueous Solution of Iodide of Potassium.—Messrs. Dossios and Weith.—The authors prepared, in the first place, perfectly pure distilled water, and employed pure iodine, free from chlorine, which they dissolved in the water, and which they ascertained to be, by means of volumetrical estimation with hyposulphite of soda, 0·01519173 grm. of iodine in 1000 c.c. of water. They found this quantity of dissolved iodine increased already after two days, and gradually increasing more and more, so much so that, about three months after having been first made, the solution contained nearly twice as much iodine. The authors ascertained the presence of hydriodic acid, conclusively proving that decomposition of water takes place. The authors also instituted a series of experiments to ascertain whether solutions of iodine in aqueous solutions of iodide of potassium are chemical combinations, or simply mixtures. The result of their experiments is not favourable to the idea that these solutions should be chemical combinations, since it is readily possible to withdraw the iodine from these solutions not only by simple solvents of iodine, but even by the passing through of a current of air. From some quantitative experiments made with perfectly pure materials, it appears that, at a temperature of 7·9°, and with solutions wherein the quantity of iodide of potassium varies from 1·802 to 12·643 per cent, the quantity of pure iodine thereby dissolved ranges from 1·173 to 12·060 per cent.

Combinations of Ammonia with Cyanide of Silver and Sulphocyanide of Silver.—M. Weith.—The author says that, when cyanides in solution are treated with ammoniacal solution of silver, a crystalline compound of cyanide of silver and ammonia, $CNAgNH_3$, is obtained, which, either on exposure to dry air, or by being placed in water, loses the ammonia; but this compound is, after all, the author states, a true combination, and not a mixture. Sulphocyanide of silver and ammonium, $CNS.Ag.NH_3$, is obtained when sulphide of silver is dissolved in warm and concentrated ammonia. It is a crystalline solid body, which is readily decomposed on exposure to air, but which may be heated up to 200° when surrounded by ammonia solution.

Behaviour of some Double Cyanides towards Ammoniacal Solution of Silver.—M. Weith.—With the view of separating the cyanogen from ferrocyanide of silver by means of peroxide of mercury, according to a plan published by Prof. Rose, the author of this paper found that this decomposition only takes place very incompletely and slowly. The same was observed when it was tried to decompose the aforesaid ferrocyanide by means of hydrate of potassa. The decomposition is, however, very readily and completely effected by boiling the ferrocyanide of silver with liquid ammonia; in that instance, the iron is separated as oxide; while the solution contains cyanide of silver and cyanide of ammonium—

$$Cy_2FeAg_4 + 2NH_3 + H_2O = FeO + 4AgCy + 2NH_4Cy.$$

The author calls attention to the fact that it is stated that ferrocyanide of silver is insoluble in liquid ammonia. This is right to a certain extent; but even in the cold, and more so on being gently heated, this fluid will exhibit, after filtration, and on addition of a few drops of dilute sulphuric acid, a more or less copious precipitate of cyanide of silver. When ferrocyanide of silver is mixed with an ammoniacal solution of nitrate of silver, instead of with ammonia only, and heat is applied, the iron is separated as oxide; while from this solution the whole quantity of cyanogen may be separated, on addition of a few drops of dilute nitric acid, as cyanide of silver. Ammoniacal solution of nitrate of silver behaves with ferro- and ferricyanides of potassium, with ferrocyanide of iron (Berlin blue), and other similar compounds (cobalticyanide of potassium inclusive), in a similar manner. Ferrocyanide of copper, however, cannot be treated in this manner, since the presence of copper gives rise to separation of silver in the metallic state.

The subject matter of all the other papers contained in this number has been treated in our columns already.

Journal de Pharmacie et de Chimie, June, 1869.

This periodical contains the following original papers:—

Researches on Protoxide of Nitrogen in Solution.—M. S. Limonsin.—The author says that the great solubility of this gas in water, especially if its temperature is rather low, induced him to try what the physiological effects of such a solution would be upon men (the author himself) and upon animals. With the main portion of his paper (being, strictly speaking, a chemico-physiologico experimental essay) we will not occupy ourselves. The solution of the protoxide of nitrogen in cold water, and obtained under ordinary pressure of the atmosphere, tastes sweetish, and decidedly saccharine, if, by means of pressure, water has been made to absorb a large bulk of this gas; as might be expected, this solution is readily decomposed by substances capable of taking up oxygen. The main point of importance in this paper is the anæsthetic action of the gas and solution alluded to.

Action of Chloroform upon Frommhers's Fluid.—M. Beaudrimont.—Frommherz's fluid is the *cupro-potassic tartrate*. The author's paper contains the results of some experiments made with the view to prove that, when even a very small quantity of chloroform—for instance, two drops—are mixed with 100 c.c. of water, and there is added thereto a small quantity of the double tartrate of potassa and copper, reduction of the latter takes place almost instantaneously when gentle heat is applied. The author has based upon this property a volumetrical method for the estimation of chloroform; and, notwithstanding the great volatility of that fluid somewhat interferes, the author has succeeded in his object. One equivalent of chloroform (119·5) reduces four equivalents of copper; 10 c.c. of Frommherz's liquid, containing 0·15 grm. of metallic copper, required 12 c.c. of a solution of chloroform, containing 1·195 grms. of chloroform, for 100 c.c.; while, of a solution of chloroform of twice the strength just stated—to wit, containing 2·39 grms. for 100 c.c.—just 6 c.c. were required.

Arsenical Aniline Reds—Aniline Red of M. Coupier prepared without Arsenic.—M. Roussin.—This being rather a practical receipt than a scientific memoir is not well suitable for abstraction.

The remainder of this periodical is filled, partly with abstracts from the *Comptes Rendus*, already noticed by us, and partly with papers relating to toxicology and *materia medica*.

NOTES AND QUERIES.

Testing Acetic Acid.—Can any of your correspondents oblige me by giving through your columns the readiest means of testing the purity and strength of acetic acid.—A. A.

Pattinson's Method for Extracting Magnesia from Magnesian Limestone.—The magnesian limestone is calcined at a dull red heat for some time. By this process the carbonic acid is expelled from the carbonate of magnesia only, but not from the carbonate of lime, which thus remains insoluble. The calcined mass is next reduced to a milk, with water, in a suitable cistern, and the carbonic acid resulting from its own calcination forced into it under powerful pressure. The result is a saturated solution of magnesia, the lime remaining unacted on so long as the magnesia is in excess. The solution, by evaporation, yields heavy carbonate, whilst carbonic acid gas is expelled and may be again used in the same manufacture. Our correspondent should bear in mind that only magnesian limestones can be thus operated upon.

THE CHEMICAL NEWS.

VOL. XX. No. 506.

THE SPECIFIC GRAVITIES OF LIQUIDS AND SOLIDS THEORETICALLY CONSIDERED.

By Dr. J. G. MACVICAR, Moffat, N.B.

IT is generally understood that Euclid shaped his Elements expressly to the end that ultimately he might be able to demonstrate the properties of the regular polyhedra, whose importance in every system of morphology he saw clearly; while Plato flew at them directly as the very forms of the elements of Nature. There is, therefore, nothing contrary to the traditions of philosophy in its highest walks in the supposition that the forms of the molecules of bodies, when they have been so far perfected as to have become individualised, possess the forms of the regular polyhedra. Now, if we suppose that the ultimate material element or unit of atomic weight or force is the same in all substances whatever—a supposition which has, also, the highest sanctions of philosophy in its favour, and which, though set aside for a time, begins again to be more and more favourably considered every day—and adopt the law of symmetry as the law by which these units of weight shall aggregate into groups or molecules which shall be more or less stable, we shall be conducted, by the progress of the synthesis, whether we will or no, to these regular polyhedra as the forms and structures in which that synthesis culminates, and specially to the *tetrahedron*, the *icosahedron*, and the *dodecahedron*, which are intimately related to each other.

Nor is there anything to be regretted in this conclusion; on the contrary, it is impossible for any one who has mastered the details of chemistry considered as a science of phenomena, and not of hypothesis, not to perceive—if he will but consent to look at that which implies a great revolution in this science—that this doctrine of polyhedral molecules explains a multitude of facts and phenomena, which, in all the lights the hitherto amorphous chemistry can bring to bear upon them, are utterly dark, and merely matters of wonder.

But, instead of indulging in general statements, let us prove this statement in reference to the weights of bodies, one of their most important physical properties. It will be admitted that the popular chemistry can tell whether a liquid or solid is light or heavy only after having weighed it either by the hand or the balance. Why a piece of sulphur should weigh less than twice as much as an equal volume of water, while a piece of zinc, whose atomic weight is about the same as that of sulphur, should weigh more than seven times as much, and, indeed, generally, why the weight of any body should be what it is, and not otherwise, chemistry can assign no reason. It has, indeed, a hypothesis of atomic volume by which (though not without continual embarrassments) specific gravities may be calculated; but that atomic volume is itself a function of the specific gravity as ascertained by weighing the substance; it is, therefore, merely a complication, not an explanation.

Now, the molecular philosophy which is here advocated solves the problem of specific gravities in the most satisfactory manner; for it does so not by introducing any new formula on this subject into science, but solely by the extension to liquids and solids of the law by which the specific gravities of aëriforms have been calculated ever since the days of Gay Lussac. Having found the right molecules which constitute liquids and crystals (the regular polyhedra, namely), it shows that their volumes tend to be equal, and either actually are equal or in a simple ratio to each other, just as has been long ago found in the case of aëriforms.

I have had occasion already to name sulphur: I will show the truth of what I have now affirmed in reference to sulphur and its companion oxygen, two elements which, after hydrogen itself, are the first to show themselves in our synthesis of the elements.

In the nascent state, they are so related morphologically that they may be viewed as the complements of each other, and the reciprocal forms of the same materials. They have accordingly in this their primal state the same atomic weight, and that is 8 when hydrogen is taken as unity. But so defective is the single atom of oxygen in a proper length of axis that, as often as two meet in the same neighbourhood, they must, under the law of symmetry, couple on the same axis; and thus the unit volume of oxygen gas will weigh $2\times8=16$ when $H=1$. Similarly so defective is the single atom of sulphur (which, to prevent confusion, we may call sulph) in its equatorial region that each atom must tend to fix three others into this region; so that sulph is to be expected in nature usually in tetratoms, the atomic weight of the tetratom being $4\times8=32$, which is an atom of sulphur, a state of things which it will be desirable to indicate in symbols, thus—

The tetratom of sulph, $S_4=\dot{S}$, one atom of sulphur.

And here I may remark that, in constituting the tetratom, the atom of sulph has come to constitute a form which is more highly oblate or negative than the single atom was prolate or positive; so that in order to lengthen the axis tetratoms, when rising into the aëriform state, tend to form unit volumes, not consisting of two atoms merely, as in the case of normal oxygen gas, but three, as in the case of that ozone which weighs 1½ times as much as oxygen gas; a mode of association being normal in the case of sulphur (except at a high temperature) which is exceptional in the case of oxygen.

If it be asked how do I come to know, or, at least, to believe, all that, the answer is that I have done so by thinking upon the subject during the leisure of a lifetime, keeping thought all the time abreast of the phenomena of nature and the laboratory. You say it is all a mere imagination, not entitled to the regard of men of science. Well, if you say so after having given this communication a fair reading to its close, I shall leave you, without further molestation, to the free enjoyment of your opinion.

I am now to deduce *à priori* the specific gravity of sulphur and its well-known combinations with hydrogen and oxygen. It is necessary only to premise further that of the two orders of forms—the trigonal and the pentagonal—under one or other of which all terrestrial elements are included, sulphur and hydrogen belong to the trigonal, oxygen and most other elements to the pentagonal. Hence, sulphic and sulphuric molecules and those in which atoms of hydrogen are centrad, must be icosahedral or tetrahedral, for, in these polyhedra, the facets are triangles, while oxygen and most other elements tend to form dodecahedral molecules, for in these the facets are pentagonal. With regard to water, whose molecule gives the unit volume for specific gravities, it is doubly trigonal (hexagonal), whence it tends to stretch out into laminæ rather than to turn round into molecules; and to constitute one particle of water no fewer than 36 atoms of vapour are required, the atomic weight of the aqueous unit consequently being $36\times9=324$, when $H=1$. No doubt without such evidence as I cannot here reproduce, you will refuse to believe all this. But you will perceive that this reference to the weight of the unit volume of the aqueous element is not necessary to substantiate the fact of my being able to deduce the relative weights of liquids and solids. It is only necessary to enable me to present specific gravities in the usual form, that is, in relation to water as unity. And here I may mention that in giving specific gravities it is usually unnecessary to go beyond the second decimal place, because even it depends on the temperature of the experimental determination as

also on peculiarities of internal molecular structure and action which we cannot enter into.

Sulphur.—Its atomic weight is 32; its form is of the trigonal order. Its molecule of culmination is therefore icosahedral, and its volume may be inferred to be normal, that is, equal to the unit volume of water, which is the great assimilative agent on the terraqueous globe. This gives—

Sulphur $G = \frac{\$_{20}}{AQ} = \frac{20 \times 32}{324} = 1{\cdot}96$. Exp. 1·96. 2·0

Here, then, we deduce the specific gravity of sulphur, as found by the balance. I have shown also that the dimorphism of the crystals of sulphur and its plasticity, when fixed by sudden cooling under molecular change at a certain temperature, are involved in the form of this element.

Hydrosulphuric Acid.—The form of the atom of sulphur being oblate or negative, it comes to pass that, in order to lengthen its axis, it must tend to fix an atom of hydrogen on each pole, giving $H\$H = H_2\$$, which is the well-known formula of sulphuretted hydrogen. Now, of this combination, as of sulphur itself, the molecule must be icosahedral, for an atom of H must be centrad, and H is trigonal as well as \$. But the molecule, consisting as it does of 20 parts, and with three elements stuck into the axis of each, must be much larger than merely the icosatom of sulphur. Allowing, then, to this molecule that which after one in simplicity of ratio comes next to one, viz., two normal or aqueous volumes, we obtain for—

Hydrosulphuric solid $G = \frac{(H\$H)_{20}}{2AQ} = \frac{20(1+32+1)}{2\times324} = 1{\cdot}05$

Now this fœtid gas when forced down into a liquid has been estimated at 0·9, and the solid has been found to sink in the liquid. Our theoretical specific gravity may therefore be regarded as accurate. But in these forced liquids and solids it is impossible to know how much aëriform matter may be included in them, increasing their bulk without a proportional increase of weight. For this reason I shall pass lightly over sulphurous acid also. Our theory gives 1·58 as its specific gravity. The liquid has been estimated at 1·45, and the solid was seen to be heavier. The theoretical number may therefore be accepted.

Sulphuric Acid, or Anhydride.—The combination SO_3 of the most modern notation is $S_4O_6 = \$O_6$ of ours. Its form is so oblate that if two come into the same neighbourhood they must couple, giving $\$O_{12}\$ = 2SO_3$ Auct. And here we obviously have the proper molecule of oxygen, namely, the dodecatom as the body of the combination, carrying a tetratom of sulph or an atom of sulphur on each pole differentiating that dodecatom. Now, these molecules are so large that if they were to form into icosatoms, as their trigonal poles would oblige them to do, they would be out of all keeping with the unit volume of water. Rather than the last of the trigonal series of polyhedrons, then the icosahedral, let us expect the first, viz., the tetrahedral molecule; we thus obtain—

Sulphuric acid $\frac{(\$O_{12}\$)_4}{AQ} = \frac{4(32+96+32)}{324} = 1{\cdot}97$. Exp. 1·97.

The tetrahedral molecule presents itself in the case of other analogous substances, that is, differentiated dodecatoms composed in great measure of elements tending to the free or aëriform state. Thus the strongest (monohydrated) nitric acid by doubling the chemical formula, as usual, gives $N_2O_{10},2HO$, which, when written symmetrically, gives—

Nitric acid $G = \frac{(HONO_{10}NOH)_4}{AQ} = 1{\cdot}55$. Exp. 1·55. 1·52.

But to return to sulphuric anhydride—

Such a structure in the terraqueous globe must necessarily be very restless, and though it is found in nature (taurocholic acid, &c.) as well as has been constructed in the laboratory, the combination of sulphur and oxygen usually stops in the production of sulphates, or, as I should say, sulphurates, which are very finely differentiated, and, therefore, very stable combinations, secure from the further attacks of oxygen by being already covered on the poles by the oxygen of the metallic oxide which enters into their composition. Following the mineralogists in using a dot for an atom of oxygen, some idea of the structure of an element of a sulphurate may be given thus—

A sulphurate .. .. $\overset{\cdot\cdot}{\underset{\cdot\cdot}{OM\$MO}} = M_2SO_4$ Auct.

Their poles being oxygens their molecules must be dodecatoms. And as they have all undergone a severe ordeal these dodecatoms may be expected to be differentiated by the fixing of a single element of the sulphurate on each pole. Taking three of the most familiar sulphates of nature, if you make the calculation you will obtain the following results—

Anhydrite.. $G = \frac{(Ca_2SO_4)_{1+12+1}}{AQ} = 2{\cdot}95$. Exp. 2·90.

Celestine .. $G = \frac{(Sr_2SO_4)_{1+12+1}}{AQ} = 3{\cdot}97$. ,, 3·95.

Barytes .. $G = \frac{(Ba_2SO_4)_{1+12+1}}{AQ} = 4{\cdot}64$. ,, 4·70.

It is time to remark, however, that both in nature and the laboratory the atom of sulphur often resolves itself into the four atoms of sulph of which it consists, and thus we have sulphous and sulphic acids as well as sulphurous and sulphuric. The presence of moisture especially assists in this partitionment. Taking sulphuric anhydride as the type in the absence of moisture, then, on the access of moisture to it, an atom of aq may be expected to attack and to fix itself on each of the four summits of the four atoms of sulph which constitute the poles. And after this it is only to be expected that the differentiated dodecatom, now rendered too diffuse, shall break up into four atoms of di-hydrated sulphic acid or glacial oil of vitriol, which, therefore, we must regard as the normal or most natural hydrate.

Glacial Oil of Vitriol.—It may be shown that one of its poles is sulphic and the other aqueous. Its molecule may therefore possibly be either the icosatom, consisting of 20, or the aqueous, consisting of 36 elements. But of these the latter plainly could not endure the high temperature of boiling oil of vitriol. Its molecule therefore must be icosahedral. Now

Glacial Oil of Vitriol $G = \frac{(SO_32HO)_{20}}{2AQ} = 1{\cdot}79$. Exp. 1·75.

When, however, this acid is produced in the cool of nature, and its stability increased by the incrustation of the molecule by lime, we obtain evidence that the aqua-form molecule has been constructed, the sulpho-calcic molecule being so large as to occupy four aqueous volumes. Thus—

Gypsum $G = \frac{(CaOSO_3.2HO)_{36}}{4AQ} = 2{\cdot}39$. Exp. 2·3. 2·4.

As to the strongest oil of vitriol which can be obtained by boiling, it has been observed by the best chemists that they cannot drive off the whole of the second atom of the water which is in the glacial acid. It has been observed that, strange to say, just 1-12th of an atom of water remains for every atom of monohydrate obtained. Now, here, when viewed in the light of our molecular morphology there is nothing strange. An atom of moisture has just twelve points or summits to which such bodies as atoms of oil of vitriol could attach themselves. And what has happened under the heat and violence of the long-continued boiling is obviously this, that the icosatoms of the glacial acid have been broken up, and the single elements of oil of vitriol, thus set free, have gathered round particles of moisture as nuclei, each atom of Aq being competent to accommodate 12 atoms of oil of vitriol around it.

That this is the true interpretation of the phenomenon is proved by the specific gravity. Thus—

Strongest oil of vitriol } $G = \frac{(SO_3.HO)_{12} + Aq.}{AQ} = 1{\cdot}843$. Exp. 1·843.

That there are sulphurides and sulphides also, as well as sulphurates and sulphates, is shown by the same test.

Sulphuride of zinc $\frac{(Zn\S Zn)_{1+12+1}}{AQ} = 4{\cdot}15$. Exp. 4·16.

But the same formula applied to galena gives G = 10·34, or, possibly, 5·17 if occupying two normal volumes, while the balance gives G = 7·4. Now, placing the metal as the body of the molecule and an atom of sulph in each pole (which must give the same percentages on analysis), we obtain—

Sulphide of lead $\frac{(SPbS)_{20}}{AQ} = 7{\cdot}4$. Exp. 7·4.

I only add that selenium comes out as baric, and tellurium as barytic sulphur, and that thallium comes out as one of a series of five metals, of which lead, gold, cadmium, indium, are other members, the body of the atom of thallium being an icosatom of sulph, and the poles atoms of sodium welded on that body.

ON

HEAT TREATED AS A SCIENCE OF KINETICS.*

By G. F. RODWELL, F.C.S.

(Concluded from p. 54).

IV. (ABSTRACT).

THIS lecture was entirely devoted to radiant heat: the principal definitions are given below.

If a mass of matter possessing a greater amount of molecular motion than the matter around it (a heated ball of metal, for example) be placed in a space devoid of all directly recognisable matter (a vacuum), it is found that it rapidly loses its motion until it assumes the temperature of proximate surrounding bodies; and, inasmuch as that motion proceeds in straight lines in every direction, like the radii of a circle, the action is known as *radiation*, and the motion thus transmitted as *radiant heat*. (*Radius*, a rod, the spoke of a wheel, related to *ραβδος*. *Radio*, to emit beams, to shine, is not unfrequently used by the Ancients; thus Lucretius "*rubent radiati lumina solis*").

It is impossible, *à priori*, that in this case there can be direct transmission of heat by conduction (Lecture III.) or by convection (Lecture III.). The motion is not communicated to visible and readily-recognisable matter, but to that infinitely subtle matter called the *ether* or *interstellar* medium (*Αιθηρ* of the Ancients—Lecture I.); and it is believed to travel in progressive waves, that is, such waves as are produced when a long cord fixed at one end is rapidly jerked up and down. There is no transference of matter, only of motion; and each particle of the ether actuated by the motion moves at right angles to the direction of transmission. (The belief in the existence of a matter infinitely more subtle than air has pervaded philosophy from the very earliest times; it is distinctly enunciated in several of the older systems of Hindoo philosophy, at least 900 years B.C. It appears in Greek philosophy—most notably in that of Aristotle; and many of the Middle Age systems are founded upon this assumption. In the "Materia Cœlestis" of Descartes, we have the ether endued with various properties, inducing conditions of physical change; among others, he has assigned to it the production of all motion, an idea which accords well with Aristotle's derivation of *Αιθηρ* from *αει* and *θεω*. In the "Phlogiston" of Stahl, we have the ether endued with various properties, inducing conditions of chemical change, the chemical phase of the "Materia Cœlestis." In some form or other, the assumption is essential to physical philosophy; for without it all radiant actions would be quite inexplicable. In support of the existence of the ether, we have—(*α*) Various phenomena connected with light, as has been shown by Euler, Huyghens, Young, and others; (*β*) the shortening of the path of Encke's comet, the period of revolution of which is 3¼ years, which is diminished by about 0·11 of a day at each revolution; and it is probable that all the visible motions of the Universe are likewise becoming lessened by the same resistance; (*γ*) the experiment of Foucault on the production of heat by the rotation of a copper disc between the poles of a magnet).*

Radiant heat is closely related to light; indeed, we have every reason for believing that the motion which constitutes heat is only a slower form of the motion which constitutes light; in a word, that the difference is one of degree rather than of form. Thus, if we heat a mass of metal, it gradually assimilates molecular motion until, at a certain point (*red heat*), it emits light, and the more motion it receives, the more intense does the light become, until at length it emits white light (*white heat*). Again, when light is decomposed by a prism, that is, when the various ether waves which, in virtue of difference of oscillation, constitute differently coloured lights, are separated, so that waves of one definite velocity appear in one definite place, it is found that, beyond the slowest waves of light, there are waves of radiant heat of extreme power.

Radiant heat is capable of *reflection* (*reflecto*, to turn back); and it obeys the same laws as light. Reflection may be defined as the turning back of the ether waves by molecules which cannot assimilate the motion thus conveyed; as when a cord is fixed to a rigid body, and caused to undulate, the wave which travels along it stops when it reaches the fixed end, and then returns, because the rigid body is incompetent to assimilate the motion which the molecules of the cord convey. (This is well illustrated by causing waves to propagate themselves by rapidly jerking a cord of hemp or india-rubber fixed at one end; the cord may be from 4 to 6 millimetres in diameter; or a small brass chain, from 5 to 10 metres in length, may be advantageously employed. It should be fixed horizontally, the room darkened, and a beam of light from the electric or oxyhydrogen lamp should be caused to illumine the path of the chain. Communicated undulations are now seen with great clearness to travel to the fixed end of the chain, and, finding there nothing which can assimilate the motion, to return as a reflected wave. The undulations of a row of particles can be shown by fixing at one end a broad and lengthy band of paper, and communicating undulatory motion, as in the case of the cord. The paper best adapted for this purpose is a kind of thin drawing-paper, sold in lengths of 36 feet, and 3½ feet broad. In regard to the mirrors to be used for showing the reflection of heat, it is quite essential to success that their axes should coincide *perfectly* (in the experiment, for example, in which a hot ball of metal is placed in the focus of one mirror, and the bulb of a differential air thermometer or a thermo-pile in the focus of another and distant mirror): this can only be the case when the curves are similar, when their centres are in the same horizontal plane, and when the lines joining the opposite extremities of each curve are parallel. The focus may be indicated to the audience by allowing a cylinder of rays of light, of the

* A course of four lectures delivered at the London Institution.

* The experiments of Balfour Stewart and Tait on the production of heat by the rapid revolution of a disc *in vacuo* appeared to support the hypothesis of an ether; but a paper in the *Philosophical Magazine* for this month (January, 1869) traces the production of heat to other causes than ethereal friction. The velocity of an ether particle must be inconceivably great, since it has been calculated by Clausius that the velocity of a particle of hydrogen at the freezing temperature is 6050 feet per second; and the ether must be conceived to be infinitely less dense than hydrogen.

same diameter as the mirror, to fall upon it, while some fine dust, such as lycopodium or a little volatilised chloride of ammonium, is diffused in the air in front of the mirror; the precise position for the thermometer in the succeeding experiment of reflected heat is thus indicated. The mirrors should be parabolic, not spherical; that is to say, their surface should be generated by the revolution of an arc of a parabola about its axis, not by the revolution of an arc of a circle about the radius which unites the middle of it to the centre of the circle to which it belongs. The smaller mirrors which are sold in this country for experiments on radiant heat are, for the most part, spherical; but very good parabolic mirrors can be obtained in Paris).

Radiant heat is capable of being *refracted* (*frango*, to break up; akin to *ραγω*); that is, the motion of the ether waves may be turned, by their passage through certain media, so as to proceed in a different direction, and in an extended form.

The *absorption* (*absorbeo*, to swallow up, or devour) of heat is the reception of the motion from the ether by molecules of matter. It is thus a reverse action to reflection; for absorption pre-supposes that the molecules of the absorbing body readily assimilate the motion. Such molecules may be represented by small wooden balls suspended in the path of a cord, which latter, when caused to undulate, communicates its motion to the balls. (This action may well be shown by fixing a tense india-rubber cord in such a way that its ends may be free; this can be done by connecting it with four rigid supports by thick string, which is fastened near each extremity, and passes away to the supports, making an angle of about 60° with the cord. This tense cord represents a row of particles of ether. A leaden ball, about 3 centimetres diameter, is suspended by two strings, so as to cause it to oscillate in one plane, the end of the india-rubber cord being the limit of vibration in one direction—that is, the oscillating ball can be caused to impinge upon one end of the tense cord. At the other end of the cord, and in various positions along its path, small wooden balls, about 3 centimetres diameter, are suspended. When the oscillating leaden ball strikes the tense cord, the latter is thrown into vibration, and communicates motion to the small balls in contact with it, thus illustrating both radiation and absorption; for the lead ball represents a molecule radiating heat (viz., communicating its motion to the ether), while the wooden balls represent molecules absorbing heat (viz., receiving motion from the ether). These illustrations may appear crude, but they at least assist an audience to realise some more or less obscure molecular actions, and a mere statement of them is scarcely sufficient).

Of the total radiation of the sun, only $\frac{1}{2,300,000,000}$ths is received by the earth. In one year, the amount of heat thus received would liquefy a layer of ice 100 feet thick, covering the entire surface of the earth. With the exception of the energy of tides (that is, the energy derived from the ebb and flow of the tides, which results from the attraction of the moon, and tends to diminish the energy of the earth's revolution), the sun is the source of all our available energy—the energy of food and fuel, of water and air in motion. The most dominant attractive forces against which this energy is exerted are—(α) *Gravity*, the attraction existing between the masses of matter (Lecture I.); (β) *Chemical affinity*, the attraction existing between dissimilar molecules of matter (Lecture I.); and (γ) *Cohesion*, the attraction existing between similar molecules of matter (Lectures II. and III.) This last,—that is, the energy expended in the internal work of a mass of matter (Lecture III.),—enormous as it is, is obviously unavailable to mankind.

The concluding remarks are given below *in extenso*.

The phenomena of the Universe, infinite as they are in variety, in form, in magnitude, and in effect, appear to be almost all produced by the interaction of attractive forces with forces of motion, the former tending to produce conditions of stability, the latter conditions of instability. These forces undergo a ceaseless round of change, in which their form alone is altered, while their actual energy, whether it be kinetic or potential, remains the same; for the sum of the energy of the Universe is a constant quantity. Circular motion may become elliptic; elliptic motion may become rectilinear; molecules may possess individual motion, or they may move in groups, or they may be actuated by both motions simultaneously; or, again, they may be influenced in innumerable ways by contiguous molecules, which may lessen their motion in one direction and augment it in another, and may change its form, intensity, character, or duration; but, throughout all these changes, the actual initial amount of energy is present in some form or other. The changes are precise and definite, and they follow unvarying and immutable laws; does it not, therefore, appear reasonable that the Pythagoreans made the most prominent feature of their philosophy the belief that unity and law and an eternal harmony prevail in the affairs of nature?

In the foregoing lectures we have briefly considered one of the dominant motions of the Universe; and we have seen how it is generated, how it influences matter, and how it passes into other forms. From first to last, we cannot fail to have noticed that it is most inimical to rest; that it ever tends to convert a condition of rest into a condition of, at least, temporary unrest. Indeed, we are almost disposed to regard *it*—a motion of molecules—as a condensed form of the motion of masses, since we have learnt that an increase of warmth in a mass of matter too slight to be felt, truly represents a force competent to lift that same mass to a height of many hundred feet; and the old Parmenidean dogma that heat is the cause of all the motion in the Universe* appears more reasonable than ever before. Not only has heat become a science of kinetics, but physical science itself is daily becoming more kinetic in its character, and there can be no doubt that other of the so-called physical forces besides light and heat will, sooner or later, be resolved into forms of motion. I have before spoken of the physical philosophy of Descartes as, perhaps, the most comprehensive kinetic system which has appeared in the whole history of science; and I am often reminded that, in our treatment of certain branches of science (specially in that of heat), we follow closely in his footsteps; in fact, our modern physical philosophy may almost be called *Neo-Cartesianism*. It is much to be wished that we adopted the Cartesian metaphysics to the same extent, in place of the pernicious Positivism† which now prevails. The philosophic spirit of the age tends towards the establishment of a syncretism between the philosophy of matter and the philosophy of mind; and, while the former has scarcely been elevated by the means, the latter has undeniably been degraded and materialised. A moment's comparison with the Platonic philosophy will convince us of this. The Positivists would have us apply to both mental and physical philosophy the same laws and the same modes of treatment; they would have us believe that only which is capable of direct demonstration; they would make the intellect infallible, and the senses all but infallible, forgetting how utterly relative is all our knowledge, and how we necessarily judge of things more in relation to ourselves than in relation to the great Universe around us.‡

* Parmenides, of Elea, according to Aristotle, Diogenes Laertius, and others, propounded this idea. It was afterwards adopted by Telesius of Cosenza, and other Middle Age philosophers, and in a modified form by Descartes.

† A good account of the most modern phases of Positivism is given by Ravaisson in his "Philosophie en France au XIXieme. Siècle."

‡ The following extract from the treatise "De Sapientia Veterum" of Francis Bacon would appear to be peculiarly applicable to a certain sect of philosophers of our day. At the same time, we do not wish to give to the word φιλοσοφος the same significance as did some of the Greek Fathers—S. Chrysostom, for example, in his charmingly eloquent Ὁμιλια εις Ευτροπιον. Pentheus, it will be remembered, hid himself in a wood, in order to be a spectator of the hidden mysteries of a Bacchanalian revel, but, being perceived, he was smitten with a

It is a hard, unyielding philosophy, which weakens some of the finer attributes of our nature, and destroys faith; it is a philosophy which engenders intense intellectual pride, for it induces our finite intellect to place itself on a level with Infinite Intellect. Rather than this, I say, let us adopt the Cartesian philosophy, and take, as our first principle of certainty, *Cogito ergo sum.** "To think," says a learned divine of our day, "is to see the chain of facts in creation, and, passing along its golden links, to find the hand of God at the beginning, as we saw his handiwork in its course."† In this spirit did Descartes think; in this spirit did he propound the first proposition of his system—"Cogito ergo sum."

The path of pure and divine philosophy is rugged with mounds which men have raised from time to time in the hope of seeing further than their fellows—back into the past, forward into the future; and many of these contain within them the festering remains of dead philosophies, which the world has buried out of her sight for their very loathsomeness. Albeit travellers often ascend these lofty tombs, allured by the hope of getting a clearer view of the distant land they seek; and, when they reach the summit, they are wearied, the time is far spent, and, as the light of day fades from their eyes, and darkness obscures the road, they lie them down, and rest side by side with the corpse of the philosophy which has seduced them. Almost at the outset of our journey, we pass a neglected mound, upon which the traveller has long ceased to rest; and it bears, in nearly effaced characters, the names of Gorgias and Protagoras. Near it, we see a greater eminence, raised by Socrates, and augmented by Cynics, and Megarics, and Cyrenaics. A very mountain bears the name of Aristotle. Many such mounds we pass; some overgrown with underwood, from which peep the ruins of forgotten shrines; some covered with asphodels and cypresses, some with myrtles and with bays, while others, again, are mere morasses, dangerous to tread upon, and rife with disease. Such an one is seen in a misshapen mound, reeking with decay, and too loathsome to approach; the home of vultures, and of ghouls, and of unclean beasts; and it bears the names of Diderot, La Mettrie.‡ Somewhat near to this, we see an eminence which, although new, is gigantic in its proportions; it is the resort of innumerable travellers of every race and of every creed, and they help to raise it higher, for they would fain climb to heaven by its means; and upon it we read the name of Auguste Comte. But what graceful peak rears its head sublime above the plain? it pierces the very clouds; it is clothed with amaranths, and it bears upon its summit a fane dedicated to Immortality. Lo! the calm, the sovereign, the ineffable spirit of Plato dwells therein. Here, as *we* travel along the path of philosophy, let us rest; here let us throw down our burden of modern Positivism, and then start afresh, Platonised in spirit and in thought.

kind of frenzy, one result of which was that he saw everything double and thus vacillated between the unreal and the real. A detail account of his doings is given both by Euripides and by Ovid, and the force of the following passage will be scarcely realised unless the reader be familiar with one or other of these accounts. "Alia est Penthei calamitas. Qui enim ausu temerario, mortalitatis parum memores per excelsa Naturæ et Philosophiæ fastigia (tanquam arbore conscensa) ad mysteria divina adspirant, iis pœna proposita est, perpetuæ inconstantiæ, et judicii vacillantis, et perplexi. Cum enim aliud sit lumen Naturæ, aliud Divinum; ita cum illis sic, ac si duos Soles viderent. Cumque actiones vitæ et decreta voluntatis ab intellectu pendeant: sequitur etiam ut non minus voluntate, quam opinione hæsitent nec sibi omnino constent: Itaque et duas Thebas similiter vident. Per Thebas enim actionum fines describuntur (cum Thebis Pentheo esset domus et perfugium). Hinc fit, ut nesciant, quo se vertant, sed de summa rerum inc erti et fluctuantes, tantum subitis mentis impulsibus in singulis circumagantur."

* "Sic autem regicientes illa omnia, de quibus aliquo modo possumus dubitare, ac etiam falsa esse fingentes; facilè quidem supponimus nullum esse Deum, nullum cœlum, nulla corpora; nosque etiam ipsos non habere manus, nec pedes, nec denique ullum corpus; non autem ideo nos qui talia cogitamus nihil esse: repugnat enim, ut putemus id quod cogitat, eo ipso tempore quo cogitat, non existere. Ac projinide hæc cognitio, *Ego cogito, ergo sum*, est omnium prima et certissima, quæ cuilibet ordine philosophanti occurrat."—*Principia Philosophiæ*, lib. i., p. 7.

† "The Limits of Philosophical Inquiry," an address delivered to the Members of the Edinburgh Philosophical Institution, on November 6th, 1868, by William, Lord Archbishop of York.

‡ The "Système de la Nature" of La Mettrie is one of the most vilely assumptive and irrational works which has appeared in the whole history of thought. Published during the most gross and rampant period of French materialism, it aimed at the destruction of ideas spiritual, ethical, and philosophical, which have ever been inseparable from the human mind; which have been cherished by races the most diverse in every age and every civilised country. Ideas which belong as much to Koung-fou-tzeu, to Zoroaster, and to the Vedic Brahmans as to Plato, Socrates, and Seneca, or to the thinkers of our day.

PROCESS FOR DETERMINING THE CARBON CHEMICALLY COMBINED WITH IRON.*

By Professor EGGERTZ,
Director of School of Mines, Falun, Sweden.

WHEN steel or pig-iron containing carbon in chemical combination is dissolved in nitric acid, a soluble brown colouring matter is formed whose colouring power is quite intense, and the solution assumes a tint which is dark in proportion to the quantity of the chemically-combined carbon.

Iron and graphite (or free carbon) do not influence this colouring; for the solution of nitrate of iron is colourless, or, at most, slightly greenish, unless extremely concentrated, and graphite is insoluble in nitric acid.

Thus, in dissolving two pieces of different steels of the same weight in nitric acid, taking care to dilute the darker solution until the two liquids present exactly the same colour, it is very evident that the more highly carburetted steel will furnish the larger quantity of liquid, and that the proportion of the volumes will indicate the relative proportion of colour in the two steels.

If now the composition and content of carbon of one of the steels is known, the absolute percentage of carbon in the other steel may be immediately deduced.

Suppose that 1 grm. of each of two steels (*a* and *b*) have been dissolved, and that the volumes of the two solutions brought to the same degree of colouring bear the relation to each other $a : b :: 5 : 7$. Knowing that the steel (*a*) contains 1 per cent carbon, you at once deduce that the steel (*b*) contains 1·4 per cent of carbon.

In applying this method of analysis, certain precautions must be taken, which we proceed briefly to point out.

In a cylindrical test-tube, dissolve gradually in the cold 10 centigrammes of wrought-iron, steel, or cast-iron reduced to a fine powder, in 1½ to 5 c.c. of nitric acid of 1·2 specific gravity (about 25° Baumé). The use of nitric acid containing hydrochloric acid must be avoided, because the solution of iron would have a yellow tint.

In proportion as the metal contains more carbon, more nitric acid must be used. After some time, when the chief part of the metal appears to be attacked, place the tube in a water-bath to the depth of about 15 m.m., and warm it to 80° C. In this position, only the lower part of the tube is in contact with the warm water; a movement takes place in the acid which favours its reaction upon the metal; a slight disengagement of carbonic acid from all the particles of carbon may be observed. The operation should always be conducted under the same circumstances as to heat and length of time.

The evolution of gas having ceased (in operating upon steel, the reaction must continue two to three hours), place the tube in a large vase filled with water, to bring the solution always to the same temperature. This precaution is indispensable, because the same liquid is darker when warm than when cold. Afterward, pour off, as exactly as possible, the clear liquid into a graduated burette. Upon the black residue remaining in the tube, pour some drops of nitric acid, and heat carefully over a lamp. If there is no further liberation of gas, the residue

* From the *Bulletin of the Chemical Society of Paris*; translated for the *American Journal of Science* by J. Wharton, Esq.

consists of nothing but graphite or silica. Cool the new solution, and add it to that which is already in the burette.

The liquid is then diluted with water until its colour corresponds exactly with that of the normal liquid, which latter should be of such a degree of concentration that each cubic centimetre represents 0·0001 grm. of carbon.

If, for instance, this normal liquid is prepared from cast-steel containing exactly 0·85 of one per cent of carbon, 1 decigramme of that steel must be dissolved in 8·5 c.c. of nitric acid; 100 grms. of steel containing 85 centigrammes of carbon would thus be dissolved in 8500 c.c. of the normal solution, 100 c.c. of that solution would represent 1 centigramme of carbon, and, consequently, 1 c.c. of the normal solution would represent 0·0001 grm. of carbon.

The normal solution does not keep, and should be often renewed, since it becomes perceptibly paler even within twenty-four hours. For it, however, may be substituted a dilute alcoholic solution of sugar properly caramelised brought to exactly the same tint; this solution keeps much longer without sensible change.

As 1 grm. of iron cannot readily be dissolved in less than 15 c.c. of nitric acid, it follows that a proportion of carbon less than 0·15 of one per cent* cannot be estimated by means of the normal liquid; but this minimum is seldom found in practice.

If the proportion of carbon exceeds 0·5 of one per cent, the ferruginous solution is so concentrated that it has a light greenish tint, which renders its comparison with the normal liquid difficult. In that case, a normal liquid of one-third the strength is prepared by diluting the normal liquid with twice its volume of water; then each cubic centimetre of the liquid represents only one-third of the ten thousandth part of a gramme of carbon. When the proportion of carbon in the specimen to be analysed is very large (as, for instance, in white cast-iron), only 0·5 grm. of the metal must be taken for analysis, and, in that case, half a cubic centimetre of its solution corresponds to a cubic centimetre of the normal solution. If the metal to be analysed contains graphite, the latter must be collected on a filter before the solution is put into the burette.

This method is more exact in proportion as the percentage of carbon is smaller. With an accurate balance, and with suitable arrangements, a great number of determinations of carbon close enough for practice can be effected in a time relatively very short.

All the Bessemer steel made at Edskin, in Sweden is marked, after hammering (*apres l' étirage*), by figures expressing its hardness, as ascertained by this colour-measuring analysis of Professor Eggertz.

It is obvious that only burettes of perfectly colourless glass must be used, or, at least, they must all have exactly the same tint.

* O. D. Allen, of the Freedom Iron Works, Pennsylvania, has found it quite practicable, by a modification of this method, to distinguish between irons containing respectively 0·10 and 0·15 of one per cent of carbon.

NOTICES OF BOOKS.

What is Matter? By an Inner Templar, Author of "More Light: a Dream in Science."

We are informed by his biographers that when the author of "The Raven" composed his extraordinary lecture on Cosmogony, he started by denying that the arcana of the universe can be explored by induction. He informed his imagination with the various results of science, and then "entered with unhesitating boldness, though with no guide but the divinest instinct, into the sea of speculation, and there built up of according laws and their phenomena, as under the influence of a scientific inspiration, his theory of nature."

But Poe, although a poet, was, in his lucid intervals, well aware of the difference between poetical speculation and hard scientific truth, and, with characteristic audacity and clearsightedness, dedicated his work "To those who feel, rather than to those who think." Poe's work was in perfect logical harmony with the rules he laid down for himself as a poet, and we therefore accept it. The work before us is in logical harmony with no laws human or divine, and we therefore reject it. When a man writes nonsense and, by publishing it, challenges criticism, it is our duty to consider whether, "though it be madness, there is method in it;" and we are forced to admit that there is method in the work before us—but not much.

When a man writes nonsense, we are also bound to consider the tone in which he writes it. If he offers us his views on the more difficult problems of the universe, and those views are obviously incorrect, still, if propounded modestly, and argued cleverly, we receive them for what they are worth, and are loth to handle their author too roughly. But the views of the author of "What is Matter?" are neither propounded modestly, nor argued cleverly, and we therefore do not feel bound to be specially lenient to him.

Doubtless the Inner Templar considers that to fairly review his book, we should analyse each chapter *seriatim* and disprove his arguments as they arise; this, however, is impossible. A long review of such a work would not only be unreadable but utterly useless, and we think that if we convict our author of want of modesty, of want of judgment, and of ignorance of the subject on which he writes, we have done as much as can be expected under the circumstances.

When a man feels that those problems which have puzzled the wisest of mankind are to him easy of solution, we can forgive him for being (for a short time) so elated as to be moved by a crowd of foolish impulses, and if, in addition, he finds that all physical phenomena, including the secret of the nature of matter, are to him as self-evident things, we can forgive him for believing himself the wisest of mankind. But, on the other hand, if we find him announcing almost incredible discoveries, as revelations from an angel, and describing the revealer and the manner of the revelation in language of that childishly pompous character which our American friends stigmatise as "high falutin," we begin to doubt whether such absolute want of judgment can co-exist with superhuman clearsightedness.

The first announcement of the work before us was contained in a pamphlet called "More Light," which we noticed a few weeks ago, and we feel bound, after again looking at it, to say that it was one of the silliest productions ever written; and yet *The Tablet* (we quote from the opinions of the press) considers itself bound to "do the writer the justice to say, that his brief narrative is pleasantly written, and constitutes a lively contribution to a class of works rarely attractive to any but scientific readers." We feel bound to do the writer of the notice in the *Tablet* the justice to say that the only redeeming point in his notice is the fact that he offers "no opinion as to the scientific value of this little treatise." In fact, it is most unpleasantly written, and constitutes anything but a lively contribution to a class of works rarely attractive to any readers whatever.

"What is Matter?" is a neat little octavo volume of 195 pages. It is excellently printed on good paper, and all rights are reserved.

The work is divided into three books, each of which is sub-divided into chapters, and there is a very complete table of contents.

The first book is principally devoted to a sketch of the opinions of the principal philosophers of antiquity, and we need not say that the continual repetition of such names as Thales, Anaximenes, Diogenes, Heraclitus, Anaxagoras, Zenophanes, Pythagoras, Empedocles, Leucippus, Socrates, Plato, Aristotle, Epicurus, Zeno., &c., &c.,

gives an air of dignity to the work which we hasten to acknowledge.

In Chapter VII. we come to a discussion on the views of Faraday, and Dr. Daubeny is severely handled for deficiency of imagination, and prejudice, and we are told that "It is painful to notice how he clings to existing notions, and appeals to common sense." We shall show further on that the last mentioned fault of the lamented Professor is one which can never be justly urged against our Inner Templar. Our author is not nearly so dogmatic upon some of the questions he discusses as might be expected from the favoured pupil of Oriel (see "More Light" *passim.*) In examining the question as to whether interplanetary space is on vacuum or a plenum, Sir John Herschel is quoted as of opinion that the sun is in a continually excited electrical state, which may account for the tails of comets being always directed away from the sun. "But" says our author "this loses a great deal of its force, as that which produces the plenum is ether; but when a vacuum is produced by experiment, it is always supposed that the vacuum is a plenum so far as the ether is concerned, for no pump has ever been constructed which touched that point, and, in fact, if the vacuum be not a plenum of ether, what becomes of the undulatory theory, for light passes through a vacuum, as is very clear, or we should not be able to see a light on the other side of the receiver, and it must on that theory have ether to be set in vibration. And if we suppose the vacuum to be a plenum of ether when the air is removed, we have had two plena occupying the same space, which, surely, is not orthodox; and if it be argued that the ether was hidden in the pores of the air, how is it that this ether continued to stay behind when the air was driven out? If, then, every vacuum must be a plenum of ether, as the undulatory theory requires, and electricity will not pass through such a vacuum; it seems clear that light and electricity differ greatly, for it appears that electricity requires *ordinary* matter for its medium, but light not. May not, then, electricity be regarded as a sublimating of ordinary matter, and light such matter sublimated? for electricity produces light, but it does not appear that light must necessarily produce electricity. Altogether, what with plena, and vacua, and ether, the subject is in as highly organised a state of confusion as the bitterest opponent of the undulatory theory could wish for."

We have made this long quotation solely that it may not be said that we have condemned a book without sufficient reason. Is it too much to say that the "highly organised confusion" is in the bewildered brain of the Inner Templar? The query as to whether electricity may not be regarded as a sublimating of ordinary matter, and light as such matter sublimated is charming, and will, we trust, be put to "Oriel" at his next meeting with our author.

We must, absolutely, make one more quotation. Our author, speaking of a ray of light proceeding from the sun, says, "Such a ray, I conceive, consists of a continuous stream of atoms travelling with different velocities, and at the same time revolving with different velocities upon axes at right angles to their line of projection. These particles are but ultimate atoms of the different forms of matter existing in our solar system, and, though so minute as to be beyond all power of weight, have, I doubt not, a considerable influence in renewing the energy which is being continually expended by our globe. This incessant pouring of millions upon millions of ultimate particles of the elements into our atmosphere, and into even the solid body of the earth, must, I think, greatly assist in explaining not only the almost universal presence of sodium —doubtless the chief cause of the yellow rays of the sun— but the presence of many other forms of matter which exist to such an extent in the atmosphere that it has been remarked that, in a cubic yard of air, might be traced the presence of almost every elementary substance. And, again, in regard to the ocean, which occupies three-fourths of the surface of our globe, who can say that the floods of light poured into its depths ages ago, when the sun's power must have been much greater, not to mention its present influence, may not have had a great effect upon its constitution—we know how its temperature is affected—and greatly contributed to the presence of those metals—especially sodium—which are a part of its constitution?" When we remember that, in "More Light," our author distinctly asserts the original matter to be nothing revolving upon an axis, that he also, in this work, states that he regards light to consist of the ultimate atoms revolving upon axes, and that these atoms are beyond the power of weight because they are so small, and that the sodium in the sea is derived from the sun's rays, we think we have proved to every reasonable person that our author is devoid of judgment in general, and that he is ignorant of the subject upon which he writes. As regards his modesty, let us quote one more paragraph from the author's "conclusion." "I have not hesitated to take the heterogeneous mass of materials supplied by every eminent man from Thales to Kant, and out of it to construct an edifice which, harmonising in all its parts, will, I trust, defy all the insidious workings of time with all the power that either talent can produce or ingenuity afford; but it is to the labours of Snellius, Newton, Faraday, and other great workers in the scientific world, that I am chiefly indebted." We ask our readers if this is not without a parallel in scientific literature?

In conclusion, there is internal evidence in "More Light" and "What is Matter?" to show that the author is a very young man. He has read much, and is by no means devoid of enthusiasm and a certain kind of cleverness. He is, however, unfortunately utterly devoid of modesty, and will, therefore, not accept advice. If he would, he might even now, perhaps, become a useful labourer in the field of science. Let him, instead of making a childish boast of never having made a single experiment, let him, we say, take up a physical or chemical question and experiment upon it earnestly and faithfully, and his mind will become disciplined, and, possibly, in his maturer years he may even acquire modesty. If he wishes to learn a great truth, let him experiment upon a subject which he has made all his own. Let him take pure water and see if, by passing the sun's rays through it, he can condense the chloride of sodium; if so, it is evident that, by the aid of "more light," he will obtain sea water. When he has condensed enough salt to be detectable by the spectroscope we will revise our review, retract our strictures, and unreservedly follow the Inner Templar as our guide, philosopher, and friend!

Revue Scientifique et Industrielle. Par EMILE KOPP, Professeur du Musée Royal et Industriel Italien à Turin. Extraits du *Courrier du Bas-Rhin.* Strasbourg: 1869.

IN this work—in which, (as somebody says) there is a thin rivulet of text meandering through a broad meadow of margin—we find nine articles, three of which, on "*Le Blanchissage Domestique*" we cordially recommend to the notice of housewives in general, and of all foreign nations —especially Sicily—in particular. Why M. Kopp has given this prominence to the subject we are at a loss to imagine unless he has fond recollections of *Blanchisseuses de fin*, and *Closerie de Lilas.* At all events, he has done good service, and shown an utter absence of pride by descending from the lofty heights of organic chemistry to the washing of linen; and what an astonishingly practical man he his! He treats of "*Inconvenients d'un trop riche Assortiment de Linge*," which, it must be confessed, few have discovered; he treats of *savonnage*, *rinçage*, *azurage*, *tordage*, and *sécharge.* We have found a frequent appeal to the dictionary necessary, and sometimes useless; let any of our readers tell us off-hand the English of *essangeage*: we had not the least idea that the French language was so rich in ablutory words, and we accept it as a happy omen. M. Kopp *must* become the hero of laundresses from his admirable ideas of economy; look here, for instance— "A la vérité le savon bien sec, surtout le bon savon de

Marseille, se dissout bien moins rapidement, et on realise ainsi une économie notable." Will some *bon savant* tell us all about "le bon savon de Marseille?"

The other articles treat of the "Anomalous Properties of Water," of "Meteorites," of "Explosive and Fulminating Substances," of "Fire Arms," of "Nitroglycerine," and of "Gun Cotton." They contain, for the most part, a good *resumé* of recent research in connection with each subject, and may be perused with advantage.

CORRESPONDENCE.

ROYAL SULPHUR SPRING, HARROGATE.

To the Editor of the Chemical News.

SIR,—In my communication on the above spring, published in your valuable journal of the 16th of July (CHEMICAL NEWS, vol. xx., p. 26), by some mishap I omitted the analysis; it is appended:—

Saline Ingredients in the Imperial Gallon.

	Grains.
Carbonate of lime	18·649
Carbonate of magnesia	1·783
Carbonate of baryta	0·291
Carbonate of strontia	trace
Chloride of sodium	538·180
Chloride of potassium	3·103
Chloride of calcium	32·327
Chloride of magnesium	27·872
Chloride of barium	0·494
Chloride of strontium	trace
Chloride of lithium	faint trace
Sulphide of sodium	9·135
Iodides, bromides, &c.	traces
Total grains per gallon	631·834

—I am, &c.,

SHERIDAN MUSPRATT, M.D.

College of Chemistry, Liverpool,
July 26, 1869.

OLEOGRAPHS.

To the Editor of the Chemical News.

SIR,—Having been from town, I have only to-day seen the CHEMICAL NEWS, and I beg you will allow me to reply briefly to Mr. Tomlinson's letter in reference to oleographs. Like every other new and valuable discovery, oleography is praised, and by others condemned. Oleography is yet in its infancy, and, just as a new and perfect process for the ultimate analysis of a complex organic substance cannot be devised in—it may be years, so we cannot expect perfection at once in this beautiful method for testing oils. I can assure Mr. Tomlinson that it is no fault of mine that he is pestered with numerous paragraphs from all varieties of journals condemning oleography. I never sent any article to one of them but the CHEMICAL NEWS on the subject, nor have I seen them. My opinion is yet the same that oleography is, in its present and very much improved state, an excellent conjunctive test for the purity of oils. No one can doubt for a moment, who has really worked at the subject carefully, that an oil figure on water can be transferred in an instant, perfectly uninjured, to paper. In the examination of trade oils, besides using oleography to assist me, I also employ the following among other tests:—

Appearance, gravity, taste, odour, rate of passage through narrow tubes, weak and strong solutions of potassic, sodic, and ammonic hydrates; shaking the oil, rise in temperature with hydric sulphate, boiling in alcohol, boiling point, burning in lamp, freezing point, passing chlorine, calcic hydrate, euchlorine, calcic hypochlorite, mercurous nitrate, hydric phosphate.

I trust Mr. Tomlinson is satisfied that I have no desire to associate his name with oleography further than to acknowledge that his name is intimately connected with cohesion figures. At many lectures I have given, here and elsewhere, in which I introduced oleography, I always took care to mention Mr. Tomlinson's name while referring to cohesion figures only. I perfectly agree with him in not wishing to describe oleography as having arrived at perfection. It is quite a young art yet; it has fulfilled all I have said, and it promises greater things.—I am, &c.,

R. CARTER MOFFAT.

Laboratory, Glasgow Mechanics' Institution,
August, 4th, 1869.

MISCELLANEOUS.

Hallogenin.—Under this name is sold in Germany a mixture of salts intended to prevent the formation of incrustations in steam-boilers. The mixture consists of 65 per cent of sal-ammoniac, 17 per cent of chloride of barium, and 18 per cent of catechu; it is said to answer its purpose very well.—*Deutsche Ind. Zeitung.*

Removal of Nitrate of Silver Stains from Woven Tissues.—According to M. Grimm, chloride of copper completely removes, even from coloured woven cotton tissues, stains occasioned by nitrate of silver; the tissue is to be afterwards washed with a solution of hyposulphite of soda, and next thoroughly washed with water. From white cotton and linen tissues, nitrate of silver stains are more readily and effectively removed by applying dilute solutions of permanganate of potassa and hydrochloric acid, followed by washing with hyposulphite of soda solution, and rinsing in plenty of fresh water. By these means the use of the highly poisonous cyanide of potassium is rendered unnecessary.—*Polyt. Notizblatt.*

Protection of Wood from Fire.—We learn from the *Deutsche Industrie Zeitung* of July 1, that at one of the collieries at Ibbenbüren, Westphalia, the woodwork is protected from fire by being painted with a mixture consisting of 5 parts of alum, 7 parts of rye-meal paste, and 30 parts of previously washed, *i.e.*, finely divided, clay (this mixture is used for woodwork not exposed to open air); for woodwork, so exposed, a mixture is used consisting of 2½ parts of crystallised sal-ammoniac, 1 part of white vitriol (commercial sulphate of zinc), 2 parts of joiners' glue, 20 parts of zinc-white, and 30 parts of water. These mixtures have been found to prevent wood bursting into flame on ignition, and to greatly delay its destruction even when severe fires are raging.

Thermoscope for Lecture Rooms.—Dr. A. W. Hofmann states that he frequently makes use of the following arrangement for the purpose of exhibiting, in a ready manner, the evolution of heat which takes place in chemical combinations and decompositions.—Some ether is poured into a tall test tube, and this tube is placed, for instance, in a recently-made mixture of sulphuric acid and water, the ether begins to boil, and its vapour may be ignited; in order to regulate the boiling of the ether it is best to place in it a platinum wire spiral. When, in a beaker glass, some sulphuric acid is first poured, and next, carefully on the top thereof, a layer of water, and these fluids are suddenly mixed by stirring the same with the ether tube, a flame of half a metre length may be suddenly evolved from the tube. The author has frequently applied this contrivance to exhibit the disengagement of heat on the sudden solidification of saturated solution of acetate of soda.—*Berichte der Deutsche Chem. Ges. zu Berlin.*

[This device was frequently adopted by Faraday during his Christmas Lectures.—*Ed.* C.N.]

Application of Leichtenberg's Experiment to the Mineralogical Analysis of Rocks.—M. S. Meunier proposes to make use of the well-known experiment of Leichtenberg's electric figures to separate from each other the divers mineralogical constituents of some kinds of rock. We briefly remind our readers that the experiment alluded to consists in charging with electricity a cake of resin or sealing-wax, by means of a previously-charged Leyden jar; it is thus possible to charge certain portions of the cake with positive, others with negative, electricity. In order to exhibit this to sight it is usual to blow, by means of a small pair of bellows, on to the cake of resin, a mixture of very finely-powdered red lead and sulphur; the friction, on leaving the nozzle, causes the powders to become electrified, and the sulphur being negatively electric is attracted by the curved figures positively electric on the cake, while the red lead follows the opposite course. M. Meunier has tried thus to separate sulphur-bearing trachite into its mineral constituents, and succeeded perfectly in getting the sulphide and feldspar from each other; he states that he has equally well succeeded with rocks made up of two different silicates.—*Cosmos.*

Analysis of Polcura.—Under the name of polcura there has been lately brought from St. Jago de Chili a mineral, met with, at a height of from 12,000 to 14,000 feet above sea level, in the Cordilleras de los Andes, imbedded between porphyry and melaphyr; this mineral exhibits a dirty yellow-coloured grainy somewhat crystalline mass; is acid and astringent to the taste; heated to 150° C., it loses 19·5lo per cent of water. 24·184 per cent of the substance is soluble in boiling water;

from the portion insoluble in that fluid, equal to 62·251 per cent, hydrochloric acid dissolves 12·351 per cent, while the remaining 49·900 per cent is silica. The portion soluble in water yielded, on being quantitatively analysed, results as follows:—Sulphate of potassa, 2·5 per cent; sulphate of soda, 2·7; sulphate of lime, 26·1; sulphate of magnesia, 16·1; sulphate of alumina, 40·2; persulphate of iron, 4·6; chloride of sodium, 0·4; and soluble silica, 7·4. The portion insoluble in water, 62·251 per cent, consists of the following substances:—Alumina, 2·007; peroxide of iron and trace of manganese, 6·700; sulphuric acid, 3·330; silica, 49·900; and water, 13·560. The polcura is applied, in the country where it is found, to the tawing of the skins of sheep, goats, and calves; from the composition of its constituents soluble in water it will be readily seen that it is eminently fit to serve this purpose.—*Dingl. Polyt. Journ.*

Bubbles of Mercury Floating on Water.—When the lecture room of a chemical laboratory is provided with a sufficient supply of water under strong pressure, it is possible to make, and exhibit there, an experiment which, owing to a deficient pressure of water in such rooms, has been almost unnoticed. The experiment is the following:—Under an ordinary water-tap, the opening of which has from 10 to 12 m.m. diameter, a large-sized porcelain basin is placed, containing from 15 to 20 kilos. of mercury; the water-tap being suddenly opened, a strong flow of water is caused to fall into the basin at a height of from 8 to 10 centimetres from its bottom. On turning off the flow of water again, it will be seen that on the surface of that fluid there float about bubbles of mercury, usually exhibiting a diameter of only 1 centimetre, but occasionally some are found of two or three times that size. As a rule these bubbles are very ephemeral; now and then, however, it happens that some may be caught, along with a quantity of water, in a small beaker glass, and, on the mercurial bubbles bursting, it will be seen how very small a quantity of mercury these bubbles consist of. Professor Hofmann mentions that he saw this experiment first exhibited in the lecture room of the Royal College of Chemistry, London, when, some twenty years ago, Professor Melsens, from Bruxelles, was on a visit there. The pressure of water at the lecture room just named is from 10 to 12 metres; in the new laboratory of Berlin University the pressure of the water circulating in the tubes and pipes is from 20 to 25 metres.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, vol. lxix., No. 2, July 12, 1869.

This number opens with a brief notice of the death of Prof. Bérard, at Montpellier, already recorded in our paper; but we meet here with the following particulars, which are of general interest:—The father of the deceased was associated with the celebrated Chaptal, in the business of an extensive chemical factory, yet in existence near Montpellier, where the manufacture of sulphuric acid was first started on the continuous principle, and whereby has been effected the cheap production of that acid, and, by its means, of almost all chemicals. The deceased Dean of the medical faculty established in the city just alluded to, had been, since 1819, one of the corresponding members of the scientific body which now is the Académie des Sciences, but which in 1819 was l'Académie, an institution of very ancient date. A very great portion of this number is again devoted to the rather barren controversy about some letters and papers, purporting to be written by men who died some 150 years ago at the least. Among the papers and communications, we notice:—

Researches on the Products of the Alcoholic Fermentation of Beet-Root Juice.—MM. Pierre and Puchot.—The authors state that they have obtained from that juice, after alcoholic fermentation—(1) vinic aldehyde, ready formed; (2) vinic alcohol; (3) propylic alcohol; (4) butylic alcohol; (5) amylic alcohol. The authors devote this paper more especially to the study of the propylic alcohol, which they say boils, in its normal state, at 98°, while its sp. gr. at 0° is 0·820; its volume at 0° being taken as equal to 1000, it becomes 1115 at 98°, at which temperature its sp. gr. is 0·735. The authors further state that, theoretically speaking, propylic alcohol can be directly formed from sugar, by simply fixation of water and elimination of carbonic acid.

New Researches on the Properties of Explosive Compounds.—Mr. Abel.—The contents of this abstract, which is published in this number at the express desire of the members of the Institute, are already well known to our readers.

Compressibility of Gases at High Temperatures.—M. Blaserna.—The author first refers in this paper to a series of researches made by him on this subject in former years, and published by him in the *Annales de Chimie et de Physique*. He next calls attention to a series of researches on this very same subject recently made by M. Amagat, which confirm both the author's researches and those made long ago by M. Victor Regnault. The author next passes to researches on the motion of gases, which, however, is a mathematico-physical paper, and not suitable for condensation in our columns.

Researches on Sulphur.—M. Chevrier.—The author has studied the action of vapour of sulphur on oxygen, hydrogen, nitrogen, protoxide and deutoxide of nitrogen, carbonic oxide, and carbonic acid. Vapour of sulphur and oxygen gas form a slightly explosive mixture under some conditions, but usually the vapour of sulphur burns off quietly, forming sulphurous acid. Hydrogen and vapour of sulphur yield sulphuretted hydrogen gas very readily and abundantly. With vapour of sulphur and nitrogen the author found no action at all. Vapour of sulphur and the two oxides of nitrogen just alluded to form, in the first place, sulphurous acid; nitrogen is set free, and if a frigorific mixture be applied to the apparatus containing the mixed gases and vapours, large so-called lead-chamber crystals are obtained. Oxide of carbon yields, with vapour of sulphur, oxysulphide of carbon. Carbonic acid and vapour of sulphur, exposed to the discharges of electric sparks, yield oxysulphide of carbon and sulphurous acid. The author of this paper adds a short notice on an—

Improvement of the Preparation of Carbonic Oxide.—When the gas just alluded to is evolved from a mixture of oxalic and sulphuric acids, as is well known, a mixture of carbonic acid and carbonic oxide gases is obtained. This mixture of gases the author causes to pass through a tube made red-hot in a suitable furnace and filled with charcoal previously well re-burnt; and, after having washed the gas through a solution of potassa, and also lime-water, he thus obtains a bulk of the pure carbonic oxide gas three times larger than would be the case if the carbonic acid simultaneously formed were not decomposed by the red-hot charcoal, which must be free from yielding any carburetted hydrogen gases.

No. 3, July 19, 1869.

This number contains the following papers, the contents of which belong to chemistry and sciences allied therewith:—

Explosive Properties of Chloride of Nitrogen and its Propulsive Force.—MM. St. Claire-Deville and P. Hautefeuille.—Chloride of nitrogen was discovered in the year 1812, by M. Dulong; It is the most unstable compound we are acquainted with, exploding most violently by very slight causes. The authors have, however, succeeded—and record in this memoir the means applied for this purpose—to estimate and measure with accuracy the force exerted by this substance when it changes its liquid for a gaseous state of aggregation. This they have effected by estimating exactly the quantity of caloric units which are set free at the moment of the explosion of the chloride of nitrogen; this quantity amounts to 38,700. The temperature of the gases, when the explosion takes place in closed vessels, amounts to 2128°, and the pressure of the gases is then equal to 3500 atmospheres, or equal to a pressure of 52,500 English lbs. to the square inch.

Spectrum Observations of Small Stars.—Rev. Father Secchi, S.J.—In a letter dated from Rome, July 13th, the eminent astronomer states that he has succeeded in studying the spectra of stars which are only of the 8th and 9th magnitude. The light emitted by such stars being very feeble, it is gratifying to learn that observation has proved that, among the spectral lines, those of carbon occur, and that the spectra, as seen, appear to prove a common origin for these small stars which are, comparatively, situated near to each other.

On Jacobsite, a New Mineral.—M. A. Damour.—This mineral owes its name to the fact that it has been found at Jakobsburg, in Nordmark, province of Wermland, Sweden. It exhibits regular octahedral crystalline shape; its colour is dark, with a metallic lustre; when pulverised, its colour is blackish brown; it scratches glass; its sp. gr. is 4·75 at 16°; it is attracted by the magnetic needle; is infusible before blowpipe flame, and loses no weight when strongly ignited in a platinum crucible; fuses readily to a bead with borax and phosphor-salt, yielding a yellowish green coloured glass; is insoluble in nitric acid, but slowly, yet completely dissolved by hydrochloric acid, while, at the same time, chlorine gas is given off. This mineral consists, in 100 parts, of:—Peroxide of iron, 68·25; protoxide of manganese, 20·57; peroxide of manganese, 4·21; magnesia, 6·41; and traces of oxide of zinc.

New Process for Obtaining Iron from its Ores.—M. Ponsard.—The author of this paper has applied Siemens's furnace to the manufacture of iron; he states that he has succeeded in producing 1 ton of cast-iron of excellent quality with a consumption of only 1 ton of fuel. The author summarises his results in the following manner:—(1) A great saving of fuel can be made, and iron obtained from its ores, without the use of blast furnace; (2) that, since the heat produced by flame is sufficient to effect all the chemical reactions and melt the metal, there may be used all kinds of fuel which produce gas—that is to say, all kinds of coal no matter whatever their quality, wood, lignite, peat, hydrogen gas, and mineral oils; (3) it is possible to obtain, at will, a more or less carburetted metal, according to the quantity of carbonaceous matter which is mixed with the ore and placed in the crucibles to act as chemical agent only. Specimens of iron of very good quality, obtained by the process as carried on by

the author, were exhibited to the members of the Academy at this meeting.

Magnetic Oxide of Iron and its Salts.—M. Lefort.—The author first reviews some experiments made by him on this subject so far back as the year 1852; he next states that, as a result from these researches, he had found that it was possible to obtain perfectly soluble and well-crystallised salts, which prove that the so-called magnetic oxide of iron (proto-sesqui-oxide) is capable of forming salts. The author prepares the proto-sesqui-oxide by precipitating, by means of caustic potassa, a solution containing a ferrous-ferric salt. The reason why preference is given to potassa is, that an oxide is obtained which is less readily affected by air, and more stable. This oxide, $FeO+Fe_2O_3+HO$, yields, after having dissolved in hydrochloric acid, and on being left to crystallise while standing over sulphuric acid, a crystalline mass made up according to the formula—

$$ClFe+Cl_3Fe_2+18HO.$$

The author has also obtained a sulphate of the following composition:—

$$SO_3FeO+3(SO_3),Fe_2O_3+2SO_3+15HO;$$

this salt, and in fact all the salts the magnetic oxide is capable of forming, are decomposed by heat far below the boiling-point of water.

Electricity.—M. Tourdes.—This is a short paper on a curious case of death by lightning, which took place on the 13th inst., at Kehl Bridge, near Strasbourg. The curious point is, that while quite close to the spot where three soldiers were seated under a rather low chestnut tree, two of whom were killed, while the third was rendered insensible and temporarily partly paralysed, there is a building provided with lightning conductors, and near, also, a very large iron railway bridge; yet the tree was struck, and the men seated under it on a bench killed, notwithstanding large masses of metal and excellent conductors of electricity were, at a far greater elevation, at hand for the electric fluid to run along. The author's opinion is that the metal buttons, and other ornaments made of metal, on the soldiers' dresses were the cause of their death by lightning.

New Acid from Sulphur.—M. Schützenberger.—While at a future date we may give a fuller account of the interesting facts contained in this rather lengthy memoir, we now confine ourselves to stating that the author has succeeded in forming a compound made up of a double atom of sulphurous acid, wherein 1 atom of oxygen is replaced by 1 atom of hydrogen; this free and anhydrous acid should be represented by S_2O_3H. The author has proposed to name this substance hydrosulphurous acid; some of its salts have been prepared by the author and obtained in crystalline state; the free acid is a very unstable compound, exerting strong reducing action.

Crystallisation of Metallic Oxides.—M. Sidot.—In this paper, the author records a series of experiments made by him in order to obtain artificially crystallised metallic oxides, starting from the well-known fact that most native oxides and sulphurets exhibit a crystalline form. The author has been occupied in researches with the view to obtain these forms by artificial means, and has succeeded, in many instances, by simply submitting some oxides—for instance, the peroxide of iron—to long-continued and strong heat. By this means, the said peroxide loses a portion of its oxygen, magnetic oxide is formed and simultaneously obtained in a crystalline shape; the sesquioxide of manganese, the oxides of cadmium and zinc, have also been obtained in distinctly crystalline state, by various manipulations and the application of suitable very high degrees of temperature.

Acetic Fermentation of Methylic Alcohol.—M. Béchamp.—The author states that on the 5th of September, 1868, he introduced into a vessel which could be properly closed, a mixture of methylic alcohol, pulp of sheep's liver, chalk, and water; and on the 15th of June last he opened the vessel and proceeded to test its contents, which he found to consist chiefly of acetic acid and non-decomposed methylic alcohol. His object was to ascertain whether methylic alcohol yields, under these conditions, any higher oxidised compound than acetic acid, which is ascertained to be the ultimate term of oxidation under the influence of the ferments used.

Journal für Praktische Chemie, No. 8, 1869.

This paper contains the following original papers and essays:—

Isomerism of the Derivatives from Naphthaline.—M. L. Schæffer.—This paper treats on naphthols, $C_{10}H_7.OH$, distinguishing—α naphthol, $C_{10}H_8O$; β naphthol; naphtholates; naphthol-ethyl ether, $C_{10}H_7OC_4H_5$; distinguished again into α and β. The paper is written with the view of proving that the isomerism of each class of bodies derived from naphthaline is a persistent character thereof; the paper is, however, too lengthy for further condensation.

Protein compounds met with in Zea-Maise, Indian Corn.—M. Ritthausen.—The author first reviews the labours of MM. Gorham, Bizio, Berzelius, and Stepf on this subject; and next states that he applied, for his researches, several varieties of maise grown in the botanic garden of Bonn University, at Poppelsdorf. The author obtained a substance which he names fibrine of Indian corn, and which contains, in 100 parts:—C, 54·66; H, 7·45; N, 15·50; S, 0·69; O, 21·70. This substance is insoluble in water, and soluble in alcohol and very weak alkaline solutions.

Alloy of Zinc and Iron.—M. Bayer.—The material here described was accidentally obtained at a Belgian iron smelting works, among a job lot of old iron. The alloy was of a very bright metallic and crystalline appearance, very brittle, so that it could be readily reduced to powder; sp. gr., 7·485; nearly entirely soluble, without residue, in dilute sulphuric and hydrochloric acids. Composition, in 100 parts:—Zinc, 83·66; iron, 13·00; lead, 2·70; tin, 0·05; insoluble residue, carbonaceous matter, 0·20.

No. 9, 1869.

This number opens with a list of the—

Symbols and Equivalents of the Elements.

And further contains the following original papers:—

On a Double Sulphide of Iron and Potassium.—M. Preis.—In order to obtain this compound, five parts, by weight, of iron, five parts of carbonate of potassa, and one part of iron (in the state of *ferrum redactum hydrogenio*) are intimately mixed, and placed in a crucible, and submitted to a gradually-increasing heat, and kept for at least one hour at bright red heat. The substance thus obtained is a compound, containing, on an average, in 100 parts:—Sulphur, 39·90; iron, 35·34; potassium, 24·16. Empirical formula, KFe_2S_4; rational formula, $KS.Fe_2S_2$.

Protein compounds contained in Oats.—Dr. Kreusler.—After reviewing the labours of Messrs. Johnston, Norton, von Bibra, and others, on this subject, the author states that he found that alcohol of ordinary strength (80 per cent) extracted the protein compounds from coarsely-ground oatmeal completely. After purifying the substance so obtained, its composition, on submitting it to elementary analysis, was found to be, in 100 parts:—C, 52·59; H, 7·65; N, 17·71; S, 1·66; O, 20·39.

The remainder of the papers are not original, and have been already abstracted by us from the original sources from which they are taken.

Les Mondes, July 15, 1869.

Although the brief notice of the following subject does not exactly belong to the subject matter usually treated in our pages, we cannot refrain from noticing the—

Steam Boiler Furnace.—Invented by M. de Pindray.—The reverend and learned editor of this periodical devotes two pages to this very interesting subject, from which we abstract the following:—Two steam boilers, of the same size, and in every respect identical to each other, were fitted up—one upon M. de Pindray's plan, the other upon the system hitherto considered the best in France—and both submitted, under precisely identical conditions, to a trial, the fuel used being the Friokaisin coal, from the neighbourhood of Charleroy, Belgium. During the trial, which lasted fully four hours, the production of steam by the Pindray system amounted to 9·440 kilos. of steam for every kilo. of coal burned; by the other system, it amounted to a production of 8·001 kilos. of steam for every kilo. of coal consumed. The indicated horse-power was (the pressure on each boiler being rigorously kept up to 4½ atmospheres) for the Pindray boiler, 124; for the other, 81. The production of steam for every square metre of heating surface amounted, in the case of the Pindray system, to 40·460 kilos., in the other case to 28·530 kilos. While the boiler fitted up to compete with M. Pindray's system of fitting up was confessedly the best, yet the latter gained 16 per cent of economy of fuel, and 42 per cent more effective force. These few data may suffice here; a saving of fuel, and a better application of heat for the purposes of production of steam are of so manifestly great interest, that we think we need not apologise for thus briefly entering for a moment on the domain of steam-boiler and furnace engineering.

July 22, 1869.

We notice from this number the following subjects:—

Wood Engraving by means of an Acid Composition.—M. Dulaurier.—The author states that, by some observations made by him previously, he was induced to try a mixture composed of sulphuric acid, several chromates, and persulphate of iron, to bite away some portions of wood upon which, after having first covered its surface with an asphalte varnish, which protects from the action of the acid composition those parts from which this varnish is not afterwards removed by an engraver's tool, he had engraved his name. This experiment, the author states, succeeded so well that very shortly wood engraving may become a greatly-improved manipulation, by means of the assistance of the biting action of acids. Unfortunately, the author neither states what kind of wood he used, nor also the precise composition of the acid mixture he has applied.

From the *accuse's de réception* of this periodical, we learn that the fifth part of the third volume of the *Archives Néerlandaises des Sciences Exactes et Naturelles*, by Dr. E. H. von Baumhauer, contains:—

Chemical Researches on the Poisonous Principle of the Root of the Cicuta Virosa.—M. Van Ankum.—This principle is an essential oil belonging to the camphine series, and is composed according to the formula $C_{10}H_{18}$; it exhibits rotatory power to the right. The root does not, according to this author, contain any alkaloid at all, either fixed or volatile.

Improved Stove and Chimney.—M. Ch. Joly.—The author states that, as a rule, the millions of chimneys applied in dwelling-houses are so badly constructed that, at the least, the useful calorific effect of the fuel is only from 5 to 10 per cent. In Paris alone, 500,000 cubic metres of wood are annually burnt, exclusive of coke and coals consumed for domestic purposes. The author has invented a combination of stove and chimney well worthy of imitation, and brought into use everywhere. His invention is based on sound principles; but, unless we reproduce the woodcuts annexed to the original, we could not make this matter well understood.

Manufacture of Chocolate.—M. Tresca.—Although this matter appears very heterogeneous, and even trivial, we must not neglect to

say a few words on this subject, taken from the ably-written report made by the gentleman just named, on the chocolate mills and factory belonging to M. Ménier, situated at Noisiel. The proprietor, well known by name, also, in this country, is the owner, also, of a large estate in Central America, entirely devoted to the cultivation of the cacao tree (*Theobroma cacao*), from which the nuts are obtained which serve for the manufacture of an article of diet which contains every element required for the due nourishment of the body. The factory at Noisiel employs 300 workpeople, and during the last ten months the quantity of chocolate made has amounted to 2,388,347 kilos. (fully 2388 tons); the quantity of tin-foil used for packing amounts to a value of 10,000 francs a month; and the duty paid by M. Ménier alone to the French *donane* amounts, for cacao alone, to a sum of nearly one and a half millions of francs yearly, exclusive of the sugar duties. M. Tresca states that the article is prepared with great care as regards the production of a really first-class and genuine material.

Cosmos, July 24, 1869.

Native Copper in Belgium.—While some drainage works were being executed at Vielsalm, province of Liège, the workmen found, at no great depth under the surface, a piece of native copper weighing about 2 kilos., and partly hollow inside, exhibiting crystals. This discovery has led to further research, the result of which is the finding of some veins of malachite.

Meteoric Appearance.—M. E. Arnoult, the well-known editor of *l'Institut*, writes from Vendôme, Département de Loir et Cher, about 80 miles south-west of Paris, stating that on the 15th of July, at 8·45 p.m., there was seen there a very bright meteor, which moved slowly from east to north, at an angle of about 45° above the horizon; it emitted a yellowish white light, so strong as entirely to overpower the light of the moon in her first quarter; it disappeared, without any perceptible noise or sound, in a few seconds, giving off a large number of very brilliant sparks. Since the writer of this brief communication is a good and trustworthy observer, and since he learned afterwards that several other parties had recognised this meteor at about the same time, there can be no doubt about the fact that a peculiar appearance had been observed.

Geological Map.—We learn from this periodical that a very greatly improved and enlarged geological map of Central Europe has been prepared and edited by the well-known geologist, *emeritus* Director-General of Mines for Prussia, M. von Dechen. This new map is on a scale of 2,500,000ths, and embraces the whole of Germany, France, England, and adjacent countries. The same author has recently finished a large geological map, in 32 large sheets, of Rhenish Prussia and Westphalia, which may be considered as one of the best ever executed of the kind, and one of the finest specimens of chromo-lithography ever published. The price of these works being very moderate, will ensure them a largely-extended sale.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 10, June 12, 1869.

This is a double number of this periodical, containing, in the first place, a very interesting and lengthy account of a *soirée* given by the president of the Society, on the 15th of May last, at the chemical laboratory of Berlin University. Following the plan of the printed periodical, we quote, in the first place, the catalogue of the brilliant exhibition of objects of interest to the scientific party assembled; this catalogue is divided into three sections, comprising:—A. Exhibition of Chemical Preparations of High Scientific Interest.—(1) M. Baeyer, Berlin, "Preparations of Indol, honystone, preparations of mellithic acid;" (2) M. Darmstädter, Berlin, "Chlormethyl-isaethionate of sodium;" (3) M. H. Wichelhaus, Berlin, "β-binitronaphthalin and derivatives of naphthol;" (4) M. Frank, Stassfurt, "Collection of bromates and other bromine compounds;" (5) M. Gräbe, Berlin, "Compounds of chinon and artificial alizarine;" (6) M. Ladenburg, Heidelberg, "Preparations of silicium;" (7) M. Liebreich, Berlin, "Protagon, neurin, oxyneurin, and salts thereof;" (8) M. Martius, Berlin, "Victoria yellow, and compounds of binitro-kresol;" (9) M. Oppenheim, Berlin, "Mentha-camphor and derivatives of propylen;" (10) M. Schaibler, Berlin, "Collection of divers kinds of sugar, and models of the crystalline form some of these exhibit;" (11) M. Wichelhaus, Berlin. "Bibromo-pyroracemic acid and naphthol." B. Exhibition of Drugs, and of Products of Chemical Works.—This catalogue is by far too lengthy for reproduction; moreover, a great many of the substances exhibited are, if not better, at least equally well manufactured in this country; we notice, however, the following rare substances manufactured on the large scale:—M. E. Jacobsen, Berlin, "Peroxide of hydrogen, made by a new and peculiar process." Among the extensive series of substances exhibited by MM. Lampe, Kaufmann, and Co., Berlin, we notice a collection of thirty different preparations of quinine; *ferrum dialysotum*; pure pepsin; a large collection of chemically pure essential oils, among which *oleum cajeputi*, *oleum calami*, *oleum neroli*, and a large number of others; a fine collection of rare kinds of opium, among these some of German cultivation. Dr. Marquart, Bonn, the owner of very extensive and eminently well-conducted chemical works, exhibited large quantities of ethyl-benzol, zinc-methyl (chemically pure), zinc-ethyl, ethyl-methylaniline, anhydrous sulphuric acid, anhydrous phosphoric acid, hydrochlorate of ethylamine, chloride of carbon, several distinct compounds of chlorine and phosphorus, aldehyde, carbonic acid ether, oxide of mesityl, and a number of similar rare compounds, all perfectly pure and fit for scientific research. M. Schering, operative chemist, Berlin, exhibited a group of crystals of re-sublimed iodine, 2 feet in diameter; several rare compounds of bromine with metals; chemically pure tannic and gallic acids; rare preparations of cadmium and mercury. C. Exhibition of Physical and Chemical Apparatus and Glass and Porcelain Ware.—This portion of the exhibition surpassed even the two former, not only for extent, but also for the exquisite novelty and finish and utility of the apparatus exhibited; we can only quote a couple out of the very many:—M. Elster, manufacturer of gas-meters, Berlin, exhibited a highly-sensitive photometer, and experimented with it during the evening in one of the rooms of the laboratory. M. Geissler, Berlin, exhibited his large mercurial air-pump, and showed experiments with it in the laboratory set apart for gas analysis.

We abstract the following from the speech of the President of the Society, Dr. A. W. Hofmann. After having welcomed his scientific guests, the Doctor first alluded to the fact that the laboratory wherein they met had not been opened in a more official manner, and a meeting held therein honoured by the presence of high and mighty officials and rulers of the empire; but, he said, it was far more agreeable to him to see assembled together, on the evening of the day upon which the finishing touch had been laid by the workpeople to this temple of science, men who would appreciate with him the importance of this achievement for the University of Berlin specially, and for the scientific world in general. The eminent speaker then entered into the history of the causes which so long delayed the building of really good laboratories at Berlin and Bonn, long after the four* other ancient universities of the Prussian empire, as it existed before the late conquests, had been amply provided with laboratories which were worthy of the advance of chemical science of the present day. The building of the Berlin laboratory, just finished though it has been in partial use for one year, occupies a space of 21·680 sq. ft. The building, of which, with the present number of the above-quoted periodical, three lithographic prints are given, exhibiting, respectively, its frontage and the plans of the ground-floor and first-floor, has cost 318,000 thalers (£47,700), which sum the Prussian Government has granted for the purpose. The speaker next commenced a lecture on divers scientific subjects, from which we quote the following:—

Increase of Weight During Combustion.—The main feature of this brief *exposé* is the description of an experiment. A small horse-shoe magnet is hung up at the beam of a balance sufficiently sensitive to turn with centigrammes; the poles of the magnet are immersed for a moment in the *limatura ferri* of the chemists' shops, and a beard of small particles of iron is caused to adhere to the poles; by means of proper weights placed on the scale-pan at the other end of the beam the equilibrium is restored. This having been done, the finely-divided iron is kindled, by approaching to it the flame of a Bunsen gas-burner, and continues to burn. While burning, it will be seen that the arm of the balance on which the magnet is suspended considerably deviates from the horizontal position, thus indicating an increase of weight on the side where the experiment is going on. This experiment succeeds best with a magnet of moderate dimensions; the horseshoe magnet applied in this instance weighed, without its armature, 210 grms., and can bear a load of 12·5 grms. of iron; when this is altogether converted in magnetic oxide, by combustion, the increase in weight will be about 4·7 grms.

Formation of Ferric Acid.—An intimate mixture is made of one part of *ferrum limatum*, and two parts of nitrate of potassa. The speaker said he took, of both together, usually from 20 to 30 grms.; these are heated in a small glass flask over a strong gas flame; the mixture soon becomes quite incandescent, emits, out of the mouth of the flask, a firework of sparks, and leaves, at last, a mass partly fused together with the glass of the flask, consisting of ferrate of potassium. After cooling, this mass is reduced to powder, and, being exhausted with water, yields a deep reddish violet coloured, nearly transparent solution. Unless great care be taken to let the mass become quite cold before any water is added, the operation is spoiled.

We regret we can only quote the titles of the following subjects briefly alluded to by the eminent lecturer, on account of the impossibility of properly giving any condensed review without reproducing the woodcuts annexed to the originals:—

Volumetrical Analysis of Hydrochloric Acid and Ammonia by means of Electrolysis.

Condensation of Hydrogen and Oxygen when forming Water-Gas (vapour of water at very high temperature).

Lecture-Room Analysis of Marsh Gas and Olefiant Gas.

Lecture-Room Eudiometer.

Equality of Volume of Oxygen, and of the Carbonic Acid and Sulphurous Acid obtained from it.

Oxidation of Ammonia.

Evolution of Oxygen from Nitric and Sulphuric Acids.

Experiments on Flame.

Lecture-Room Thermoscope.

Comparison of the Volume of Different Gases submitted to the same Changes of Temperature and Pressure.

Compression of Gases by means of the Pressure exercised by a Column of Mercury.

Liquefied Sulphurous Acid Gas.

Bubbles of Mercury Floating on Water.

Local Ventilation as Lecture-Room Experiment.—This last paper contains a brief *resumé* of the excellent mode of ventilation adopted in the lecture-room of the Berlin laboratory.

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* Prussia Proper has Universities at Breslau, Königsberg, Greifswald, Halle, Bonn, and Berlin; and, in addition, the universities of Göttingen, Marburg, formerly belonging to the Kingdom of Hanover and the Duchy of Hesse Cassel, are now Prussian Universities.

On the 24th of May last the Society held one of its ordinary meetings, at which the following papers were read and communications made:—

Behaviour of the Trichlorinated Acetic Acid Salts and of Chloral with the Animal Organism.—M. Liebreich.—This physiologico-chemical paper is partly an answer to the question the author put to himself—Whether, during the splitting-up of such chemicals, of which the physiological effects of the bodies they separately yield on being split up is well known, the splitting-up thereof in the animal organism itself brings on the same phenomena as if the component substances were individually administered to an animal? As far as the author's experiments go, they seem to prove that the splitting-up of substances as those experimented with and named in the heading to this paragraph, actually produce phenomena, from which it is just to infer that they are produced by products derived from the splitting-up of the substances experimented with.

Action of Sulphide of Carbon upon Oxamide and Acetamide.—M. Ladenburg.—The decomposition of oxamide sets in at 180°, and is not quite finished at 200°. In order to avoid explosions, the sealed tubes have to be opened after several hours' exposure to heat. Among the gases which escape on opening the tubes, oxysulphide of carbon is the chief, mixed, however, with some oxide of carbon and hydrosulphuric acid. The reaction may be represented by the following formula:—$C_2O_2N_2H_4 + CS_2 = CSNH.NH_4 + COS + CO$. As to the reaction of acetamide and sulphide of carbon, the author states—"I have never been able to get it satisfactorily ended; it begins below 200°, at 210° a strong disengagement of gas takes place, and at a higher temperature the tubes always exploded. The disengaged gases contain much H_2S, COS, and CO, also vapours of hydrocyanic acid, and combustible gases not absorbable by baryta-water and protochloride of copper. In the residue in the tube, only sulphocyanide of ammonium and acetamide were left.

Formulæ of Benzol.—M. Ladenburg.—It is impossible to give a proper abstract of this paper without reproducing the woodcuts representing certain mathematical figures essentially belonging to this paper.

Contribution to the History of the Salicyl Compounds.—M. Henry.—After referring to a series of experiments made by the author with the view of exhibiting the action of pentachloride of phosphorus upon salicylic-aldehyde, the author now communicates the results of his researches on the action of pentabromide of phosphorus upon salicylic aldehyde. This action, he says, although less violent than that of the pentachloride of phosphorus, is yet rather strong. On purifying, first with water, and afterwards with ether, the substance resulting from this reaction, he obtained monobromated salicylic aldehyde—

$$C_6H_3Br\begin{cases}OH\\CHO.\end{cases}$$

When two equivalents of pentabromide of phosphorus were made to act upon one equivalent of salicylic acid, a substance was obtained which, after having been purified by means of ether and alcohol, exhibited a crystalline appearance, fusing at about 165°, and subliming at between 150° and 155°; formula—

$$C_6H_3Br\begin{cases}HO\\COHO.\end{cases}$$

Salicylic acid methyl-ether is not acted upon in the cold by pentabromide of phosphorus, but, on heating, among a series of secondary products, a substance is obtained named monobromo-salicylic acid ether—

$$C_6H_3BrCO(CH_3)O.$$

It is a solid, fusing at between 36° and 38°, and boiling at about 266°; its alcoholic solution is coloured beautifully violet on addition of a few drops of an alcoholic solution of perchloride of iron.

Researches on some Ethereal Derivatives of Polyatomic Acids and Alcohols.—M. Henry.—Unless we were to fill about a column of our pages with formulæ only, the condensed reproduction of this paper would neither do credit to its author nor be of use to our readers; we therefore only quote the title.

Contribution to the Chemical History of Diallyl.—M. Henry.—This is a preliminary notice on diallyl, C_6H_{10}, from which we learn that diallyl readily combines with N_2O_4, yielding a solid mass of white crystals composed according to the formula $C_6H_{10}(NO_2)_4$. Diallyl also combines with hypochlorous acid, yielding a fluid heavier than water, formula—

$$C_6H_{10}\begin{cases}(OH)_2\\Cl_2.\end{cases}$$

On the Stilben Series.—M. Grimaux.—This paper, owing to the large number of formulæ necessarily belonging to it, is not well suited for abstraction.

Annalen der Physik und Chemie, von Poggendorff, No. 5, June 15, 1869.

This periodical contains the following original papers:—

Definition of the Course of the Boomerang.—Dr. E. O. Erdmann.—A purely mathematico-mechanical essay.

Researches on the Behaviour of Vapours as regards the Law of Mariotte.—Dr. H. Herwig.—A lengthy physico-mathematical monograph on this subject, not suited for abstraction.

Nature of the Liquids found Enclosed in certain Minerals.—MM. Vogelsang and Geissler.—The authors review, in this paper, first, the labours of Davy, Simmler, Brewster, and others on this subject, and next state that they have applied for their researches spectrum analysis and microscopic research. Without a reproduction of the engravings accompanying this paper, it would be impossible to make the apparatus, and the mode of action thereof, understood. It appears as chief result of the researches made by these authors, that liquefied carbonic acid and water are very commonly met with enclosed in various minerals.

Researches on the conditions Influencing the Evolution of Bubbles of Gas and Vapour, and on the Forces which thereby come into Play.—M. H. Schröder.—This paper is the first instalment of a lengthy essay on a rather intricate subject. Since the author intimates that he will give a condensed *resumé* of the main results of his researches at the end of his essay, we prefer not to go into particulars just now.

Reduction of Accurately-Made Weights, and Determination of the Error of Absolute and Relative Weighing without Reduction.—Dr. K. L. Bauer.

Construction of Galvanoscopes which are Extremely Sensitive.—M. H. Weber.—These are purely mathematical papers.

Form and Constitution of the Puddling-Dross Crystals obtained at the Steel-Works, Hombourg-Haut, near St. Avold, Département de la Moselle.—M. Kosman.—After reviewing the labours of others on this subject, the author first enters into a lengthy and purely crystallographical description of the crystals alluded to in the title. The specific gravity of this material is 4·44, the colour of the powder bluish green. In 100 parts, the substance contains:—Metallic iron, 0·29; monosulphuret of iron, 1·43; phosphuret of iron, 3·31; peroxide of iron and sesquioxide of manganese, 5·99; Fe_2O_3, 4·79; protoxide of manganese,* 0·75; lime,* 1·16; phosphoric acid,* 1·48; silica, 24·04; protoxide of iron, 47·50; protoxide of manganese, 7·35; lime, 0·82; magnesia, 1·49.

Determination of Galvanic Resistance.—M. J. Sirks.—A mathematical paper.

Spectrum of the Aurora Borealis.—M. J. A. Angstrom.—This paper is taken from the author's work, highly spoken of by M. Poggendorff, "Researches sur le Spectre Solaire," 4to, Upsal, 1868, avec Atlas de Six planches. The light exhibited by the Aurora Borealis is almost monochromatic, and shows one single bright line to the left of well-known lines of the calcium group.

Fluorescent Liquids for Geissler's Tubes.—Dr. Seilhorst.—The researches of this author have brought to light the fact that a good deal of deception is practised by the makers of the tubes, who make inaccurate statements as to the nature of the fluids they contain. The author found that *tinctura rad. curcumæ* answers best for yellowish green, *tinctura sem. daturæ* for deep green, *tinctura guajaci* for deep blue, *tinctura ligni quassiæ* for bright blue, *tinctura corticis Æsculi* for bluish green, and petroleum for bright blue. The author could not obtain a red fluorescence; all the tinctures are alcoholic.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 198, June, 1869.

This periodical contains the following original papers:—

Report on the Chocolate Manufactory of M. Ménier, at Noisiel (Seine et Marne).—MM. Tresca and Duchesne.—This report has been already alluded to by us, abstracted from another paper.

Report on a Peculiar Process of Dyeing a Fast Grey.—M. Barreswil.—The author states that MM. Bretonnière and Co., at Laval (Mayenne), have introduced very successfully the use of protonitrate of mercury as a mordant; and they apply, as dye, a solution of sulphuret of potassium, using 1 kilo. of that salt to 18 kilos. of woven tissue, or yarn, dissolving the salt, of course, in a sufficient quantity of water. The colour thus produced is essentially due to the formation of sulphuret of mercury on and in the tissues; and, according to the author of this paper, the colour is fast, that is to say, not destroyed by washing with soap or alkaline lyes, and resisting acids, but destroyed by chlorine.

Purifying of Syrups and Molasses by means of the Osmogène.—M. de Luynes.—This paper describes the details of M. Dubrunfaut's method of refining coarse syrups and molasses, by an apparatus called osmogène; but, unless the engravings annexed to this paper were reproduced by us, it would be impossible to understand the description properly.

The remaining papers in this number are—The continuation of a lengthy paper on—

Electro-Magnetic and Magneto-Electric Apparatus for Medicinal Applications;

A continuation of a report—

On the Culture of Truffles;

And a paper relating to locomotive engines.

NOTES AND QUERIES.

Vacuol.—I have met frequently in recent Continental journals with the terms "vacuol" and "vacuolised," in reference to fungi or the cells of fungi. I cannot find these words in Watts's "Dictionary," or in any of the foreign scientific dictionaries. Can any of your readers tell me the meaning of these terms, and with whom they originated?—Carbon.

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* The analyst considers that these three, equal to 3·39 per cent, are combined together according to the formula—

$$(3MnO,PO_5)+2(3CaO,PO_5).$$

THE CHEMICAL NEWS.

VOL. XX. No. 507.

ON THE
METHODS OF ANALYSIS
AND THE
COMPOSITION OF VARIOUS CHEMICAL MANUFACTURING PRODUCTS.

By M. GASTON TISSANDIER.

OUR object in publishing these memoirs from the *Moniteur Scientifique* is to furnish manufacturers and manufacturing chemists with practical methods of analysing with rapidity and certainty the most important productions of commercial chemistry, and also to give an account of their composition. Special treatises are not wanting containing methods of estimating and separating substances which are subjects of investigation to chemists; but we know of the existence of no collection where the description of a process for analysing such and such a commercial product may be met with. It should be added that the methods here published are not original, and offer nothing in the way of novelty, but are employed by most chemical experts. All that we have done is to make a few trifling modifications in a small number of cases. The efficacy of these processes we can in all cases guarantee by the practice acquired by us three years ago in the *Laboratoire d'Essais et Analyses Chimiques de l'Union National*, where we have already performed more than three thousand experiments of all kinds.

I. ON CRUDE POTASHES.

Manufacture of Beet-Root Salts.—Almost all the salts of potash now manufactured are extracted from beet-root, the crude salts or potashes being made by calcining the residues of the evaporation of weak vinegars proceeding from the distillation of molasses. These vinegars were formerly evaporated in copper basins; but the acids developed by too active or imperfect fermentation, or thrown in to hasten decomposition, were found to attack the copper, which soon led to the substitution of wooden vats—an important change, which was first effected by M. Coupier. Not long afterwards, another important step was taken by M. Porion, of Vardrecques, who, in the manufacture of salts, evaporated the vinegar partly by the direct action of fire, and partly by the combustion of the charcoal which exists in the organic substance of the vinegar. The Porion stove, which is now almost universally employed, consists of a long vaulted chamber, having at one end from two to three reverberatory furnaces, and terminating in a chimney, near to which is the tap which turns on the vinegar. This chamber is traversed through its largest extent by a paddle shaft, which agitates the vinegar violently, and causes it to fall in showers into that part of the stove which is subject to the direct action of the flames from the reverberatory furnaces. When the vinegar subjected to this preliminary process is sufficiently evaporated, it is placed upon the sole of the furnaces, where, under the action of the fire and vigorous stirring, it soon assumes a pasty form; after which it quickly takes fire, and becomes itself a source of heat, by means of which fresh quantities of vinegar may be evaporated. Calcination being at an end, the salts are thrown upon the ground, and spread out upon a large space, where a final combustion occurs spontaneously.

The calcination of vinegar residues in the Porion stove requires great intelligence and practice on the part of the operators, on account of the difficulty as well as importance of seizing the proper moment for stopping the calcination. If this latter be carried too far, the potash will melt, thereby producing a substance difficult to lixiviate. The appearance of the melted potash is that of a very hard, close stone, of a light grey colour, veined with white, on concussion giving a dull sound. If, on the contrary, calcination be too soon arrested, the product is a pasty mass, which quickly cools and agglomerates, yielding brown and frothy lixiviums, difficult to treat in refining. The refined products which ensue are never white, but always of a greenish blue tinge, due to the presence of certain unoxidised or non-volatilised sulphides. The appearance of an imperfectly calcined salt is that of an earthy, brown, close substance, not very hard, tinged throughout with reddish tints, and veined with green and violet lines. If a salt of this kind be wetted, an evolution occurs of the characteristic odour of rotten eggs.

In the preparation of salts, it is most important to remove them from the furnace just at the proper time; and the duration of the calcination varies in accordance with the kind of beet-root employed; thus, when the residue under treatment is that made from Picardy beet-root, which is rich in carbonate of soda, the removal must take place sooner than with residue from the beet-root of Artois.

The disposition of the salts in the heaps where combustion takes place also requires careful superintendence; because, if a heap gets too hot, the potash will run; and if, on the other hand, the temperature does not rise enough, the potash will be imperfectly separated. Salts rich in carbonate of potash are heaped in beds from 30 to 50 centimetres thick; the poorer salts in beds of 2 metres thickness.

A well-made salt ought to present the appearance of a porous stone, very light, friable, and sonorous as pumice-stone; its prevailing colour should be greyish red. Salts contain alkaline carbonates, chlorides, sulphates, substances insoluble in water (charcoal and carbonate of lime); also small quantities of sulphates, and, accidentally, cyanides, sulphides, silicates, ammonia, &c.

Mode of Analysis.—The sample to be analysed should be pounded and sifted. About 30 grms. must be taken and finely pulverised in a porcelain mortar. 25 grms. of this impalpable powder are weighed off, and placed in a flask capable of holding 500 grms., and containing about 200 grms. of distilled water; it is then boiled for a quarter of an hour, and left to settle, that the insoluble substances may collect at the bottom of the vessel. The clear lixivium is decanted upon a filter placed on a measuring-glass, guaged to ½ litre. The insoluble substances are again treated with cold water, and so on, for three or four times. Lastly, the insoluble substances are thrown upon the filter, and washed with boiling water until the filtered lixivium occupies exactly the volume of ½ litre. This lixivium, when cool, is stirred until it becomes homogeneous, and divided, by means of a pipette, in the following way:—

1. Deduct 100 c.c. (corresponding with 5 grms. of salts), in order to obtain the alkalimetrical standard; these 100 c.c. must be transferred to a ½ litre flask.
2. Another 100 c.c. to be poured into a ½ litre glass, to estimate the sulphuric acid.
3. Fifty c.c. (equal to 2 grms., 5 decigrammes) of salts to be poured into a stoppered bottle of 250 c.c., to estimate the chlorine.
4. Ten c.c. (equal to 5 decigrammes) to be poured into a porcelain capsule of 200 c.c., to estimate the potassium.

Insoluble Substances.—These must be dried at 100°, removed from the filter, and weighed. By calcining them, and weighing the ashes, the proportion of charcoal and organic matter will be obtained by difference.

Determination of the Alkalimetrical Standard.—A standard liquid must first be prepared containing exactly 100 grms. of sulphuric acid per litre (SO_3HO). For the preparation of this liquid, we refer to chemical treatises, only remarking that it should be carefully tested before

use. This may be done either by taking as a standard perfectly dry and pure carbonate of soda, or by estimating the sulphuric acid contained by means of chloride of barium. A graduated alkalimetrical measure is filled with the liquid, which is poured, after the addition of a few drops of litmus solution, into the phial containing the 100 c.c. of lixivium or 5 grms. of salts. When the solution has become purple, it is boiled, in order to remove the carbonic acid, and then recovers its original blue colour. Fresh quantities of sulphuric acid are now added, and it is again boiled. This is repeated until the addition of another drop of standard liquid causes the solution to turn from blue to vinous red, and boiling fails to restore it to blue. By reading the number of divisions corresponding to the volume employed of standard liquid, the alkalimetric standard is obtained: thus, if 44 divisions, or 44 cubic demi-centimetres, are used, the standard will be 44°.

Estimation of Chlorine.—One of the best processes for estimating chlorine in potashes is the employment of a standard silver liquid and a solution of neutral chromate of potash. 47·886 grms. of fused nitrate of silver are first dissolved in distilled water, and then diluted so as to form a liquid 1 litre in quantity. 1 c.c. of this liquid will precipitate 1 centigramme of chlorine. Several cubic centimetres of a saturated solution of chromate of potash are poured into the flask containing 50 c.c. of saline lixivium; and the silver liquid is then added, drop by drop, by means of a measure graduated in tenths of cubic centimetres, until the lixivium, augmented by the chromate of potash, turns red. If 14 c.c. of silver liquid, or 140 divisions, be used, 2·5 grms. of the salts will be found to contain 14 centigrammes of chlorine, reckoned in the summary as chloride of potassium.

The chromate of potash may be dispensed with; in that case, the portion of lixivium in which the chlorine is to be estimated is acidulated by pure nitric acid; the standard silver liquid is poured immediately into it, and the precipitated chloride of silver collected at the bottom of the vessel by quick stirring. The exact quantity of silver necessary to precipitate all the chlorine is easily ascertained; and care must be taken to stir the precipitate whenever fresh drops of the silver liquid are introduced. With practice, this method will be found as quick and accurate as the preceding.

Estimation of Sulphuric Acid.—This may be effected by means of chloride of barium. The 100 c.c. of lixivium are acidulated with pure chlorhydric acid, and chloride of barium is added. The precipitated sulphate of baryta is allowed to settle for twelve hours, and need then only be collected on a filter, washed with boiling water, and weighed after desiccation and calcination.

Estimation of Potassium.—By means of bichloride of platinum, the potassium is deposited under the form of chloroplatinate of potash. The 100 c.c. of lixivium corresponding to the 5 centigrammes of salts are acidulated with pure chlorhydric acid; an excess of bichloride of platinum dissolved in water is added in the same capsule, and the whole is then evaporated almost to dryness in a water-bath; at the same time, it is very important not to desiccate the precipitate, which, when taken out of the water-bath, should be moistened with at least 1 c.c. of liquid. On attaining this point, it is washed by decantation with ethereal alcohol (4 volumes of alcohol at 40°, and 1 of ordinary sulphuric ether), and thrown upon a small filter. It is again washed upon the filter with a small quantity of ethereal alcohol, dried at 100° in the water-bath, carefully removed from the filter, and weighed in a sensitive balance. It answers to the formula $KCl,PtCl_2$, and the amount of potassium contained in it may be easily calculated. Some chemists do not filter the chloroplatinate of potassium, but wash it by decantation in a vessel of Bohemian glass, where it is evaporated, and dry it in the same vessel in the water-bath. The very light precipitating vessel is tared before the operation, and, by weighing it together with the contained precipitate, the difference obtained is the weight of the latter. In treatises on chemistry, the chloroplatinate of potash is generally recommended to be filtered on a tared double filter—an unnecessary precaution with the proportions here mentioned. When the quantity of salts employed is 5 decigrammes, the precipitate obtained always weighs about 1 grm.; and the amount of substances which adhere to the paper is quite insignificant. To effect this process under good conditions, the best plan is to use a standard solution of bichloride of platinum, in order to be certain beforehand of using neither a too weak nor too powerful reagent. The platinum may be dissolved in the state of sponge by means of aqua regia, in the proportion of 60 grms. per litre, and diluted with water after evaporation: 10 c.c. of this liquid will be required to estimate the potassium.

Moisture.—The moisture contained in a salt may be estimated by drying 5 grms. on a stove, heated to 120°, failing which a small closed tube may be used, into which 5 grms. of salts are placed, and dried over a jet of gas, the water condensed at the upper end of the tube being soaked up with a plug of filtering-paper. The tube is weighed empty, and again with the desiccated portion of the salt, and the difference given is the proportion of water.

Calculation of the Analysis.—The estimated chlorine is transformed into chloride of potassium, the sulphuric acid into sulphate of potash. The quantity of potassium contained in the chloride and sulphate is calculated, and then deducted from the total of potassium yielded by the chloroplatinate. The excess of potassium is transformed into carbonate of potash. The standard corresponding with the carbonate of potash is calculated, and subtracted from the total standard, and the excess of the standard is transformed into carbonate of soda. The form of the analysis is drawn up in the manner indicated below.

Phosphates are sometimes contained in salts, but in small quantities, and, in analyses for purposes of manufacture, it is generally useless to pay any attention to them.

The mode of analysis here described gives very precise results; and, when practice has been acquired, the separation of potassium and sodium occurs with great exactitude. It has been proposed to separate the potassium by means of tartaric acid; but we believe that this process would be neither so practical, nor so rigorously exact as the one we have described, whilst with the *natrometer* its results would be merely approximative.

In the course of three years, more than 1000 specimens of salts and refined potashes have been analysed by us, an example of which we subjoin below.

COMPOSITION OF BEET-ROOT SALTS.

Substances estimated.	From l'Aisne (1).	From the Somme (2).	From the environs of Lille (Nord)	From the environs of Lille.	From l'Aisne (3).	From the Nord.
	I.	II.	III.	IV.	V.	VI.
Moisture	4·00	2·59	3·48	7·72	2·47	1·19
Insoluble matter	13·50	10·61	14·02	12·08	11·60	13·11
Chloride of potassium	18·86	15·10	20·48	33·76	10·28	29·82
Sulphate of potash ..	5·71	11·62	11·20	5·75	3·83	2·97
Carbonate of potash ..	44·28	44·70	24·72	17·00	53·50	36·50
Carbonate of soda ..	13·48	15·28	26·01	23·50	8·18	16·20
Non-estimated and loss	0·17	0·10	0·09	0·19	0·14	0·21
Total	100·00	100·00	100·00	100·00	100·00	100·00

(1). Product manufactured by the Societé des Usines de Montjean et Channy; MM. Bayard de la Vingtrie, Frères, et Cie.

(2). Ham Distillery (Somme), MM. Hurbain-Désormeaux.

(3). MM. Gunguièz et Cie., Bucy-le-Long, near Soissons.

Specimens No. 1 and 2 may be considered as types of salts of good quality. No. 5 is one of the richest with

which we have met, and Nos. 3 and 4 are the poorest. The composition of the crude potashes varies extremely, as is self-evident, each constituent element occurring in different proportions in the various examples. We have been asked by some chemists why the composition of salts has been thus formularised, and how we could prove that they did not contain, say, for instance, chloride of sodium. Setting aside the established custom in all commercial refineries of combining the elements in the mode we have adopted, our answer is that refining itself proves that this formula points out the true composition of the salts. If the refining be well conducted, all the salts indicated by this formula will be obtained, and in almost exactly the same proportions.

Potashes Derived from the Grease of Wool.—Before terminating our account of salts, a few words may be added relative to the potashes derived from grease extracted from wool-washings. The potashes made from grease analysed by us were produced by M. Thery-Disière, who is at the head of an important manufactory at Verviers (Liège), and who was the first to use baths for the purpose of steeping wool, which was, formerly, always thrown into the river. Here is the composition of one of these potashes—

POTASH OF WOOL GREASE.

	I.	II.	III.
Moisture	2·83	1·20	1·05
Insoluble matter	11·98	5·28	11·19
Chloride of potassium ..	5·88	6·12	7·04
Sulphate of potash ..	2·48	3·03	3·33
Carbonate of potash ..	71·52	79·01	72·25
Carbonate of soda	4·96	5·15	5·14
Non-estimated and loss	0·35	0·21	5·14
	100·00	100·00	100·00

Potashes extracted from wool-grease are produced in several manufactories in France, and constitute an excellent product, rich in carbonate of potash; but an important progress in this branch of manufacture yet remains to be realised, viz., the diminution, or even complete removal, of insoluble matter without recourse to refining.

REFINED POTASHES.

Refining the Salts.—The salts are broken into fragments the size of an egg, and lixiviated in water. The lixivium should mark from 20° to 25° on the Beaumé areometer; it is passed into cauldrons, where, by successive evaporations, crystallisations, and solutions, the separation of the salts is effected.

In the first set of cauldrons, the lixiviate is evaporated until it marks 40° on the Beaumé areometer; at this density, most of the sulphate of potash is precipitated. The liquid is left to settle, and decanted into crystallising pans, where the greater part of the chloride of potassium crystallises when quite cold.

The mother liquor is evaporated in the second set of cauldrons until it marks 45°, during which process it precipitates carbonate of soda. After settling, the lixiviate is again passed into the crystallising pans, where, on cooling, a new deposition of chloride of potassium takes place. The lixivium is again heated in the third set of cauldrons, and rendered sufficiently concentrated to mark either 50, 51, 52, or 53 areometric degrees. Carbonate of soda is still deposited; the liquid in the crystallising pans, when cool, still precipitates chloride of potassium, and, when evaporated to dryness, yields commercial refined potash, generally containing from 78 to 82 per cent of carbonate of potash. In order to obtain potashes refined to a still higher standard, these are dissolved at 80°, and the solution evaporated to 61 or 63 areometric degrees. Carbonate of soda is deposited, and the liquid obtained, when evaporated and calcined, yields potashes containing from 88 to 94 per cent of carbonate of potash.

Sulphate of Potash.—It has been shown that the greater part of the sulphate of potash contained in the salts was deposited during the first evaporation of the lixivium. This salt, polluted in the first instance by the impurities of the lixivium, contains, besides the alkaline carbonates, chloride of potassium. By means of rakes, the salt is taken up as it precipitates, placed to drain in vessels of perforated sheet-iron, dissolved, and subjected to a fresh crystallisation. Commercial sulphate of potash is thus obtained.

Chloride of Potassium.—The chloride of potassium successively deposited during the different phases of evaporation of the lixivium is left to drain, and, when deprived of the liquid which moistens it, is saleable. After the second or third cooling, it is not, however, sufficiently pure to be introduced into trade, and must be collected and restored to the first set of cauldrons, there to be operated upon anew.

Carbonate of Soda.—The carbonate of soda produced by evaporation of the lixivium is purified, after desiccation, by means of successive solutions and crystallisations, repeated two or three times. The soda-salt thus obtained furnishes, after calcination, commercial white soda.

It is, of course, understood that these evaporations never produce salts in a state of complete purity, and that all products thus obtained are mingled more or less with other substances. Sulphate and chloride of potassium and carbonate of soda are manufactured by other processes than those we have described. On this subject a few words will be said when discussing more especially these different salts. We will at present confine ourselves to an examination of the composition of refined potash (carbonate of potash).

METHOD OF ANALYSIS AND COMPOSITION OF REFINED POTASH.

The analysis of refined potash is effected in a precisely similar manner to that of crude potash, except that it is more rapid, on account of the non-necessity of separating the insoluble substances, which occur in only the smallest proportions.

Twenty-five grms. of refined and pulverised potash are dissolved by decantation in a flask, and the obtained lixivium is diluted to the volume of 500 c.c. Decant 100 c.c. to obtain the standard, 100 c.c. to estimate the sulphate, 50 c.c. to determine the proportion of chlorine, and 10 c.c. to estimate the potassium, by means of bichloride of platinum. The moisture is estimated by heating the potash-salt to a red heat in a platinum crucible. The analytical results given below may be considered as representative types of the different qualities of

Substances estimated.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.
Moisture and insoluble ..	3·05	0·80	0·61	0·68	2·00	0·38	5·66	0·21	0·42	15·56
Chloride of potassium ..	3·21	3·35	2·61	3·22	3·41	3·41	4·68	5·81	4·00	1·47
Sulphate of potash	2·31	1·48	0·80	2·00	4·62	1·41	2·00	3·45	2·10	0·11
Carbonate of potash ..	78·10	81·22	91·25	91·88	87·51	92·87	69·25	82·68	89·37	79·86
Carbonate of soda	13·33	13·15	4·73	2·22	2·46	1·93	18·41	7·85	4·11	3·00
Total	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
	Corbehem Distillery, near Douai; M. A. Lefebvre.			MM. Tillog-Delaune and Co., Courrierès (Pas de Calais).			X	MM. Vorster et Gruneberg, Cologne (Prussia).		Hydrated potash; maker unknown.

commercial refined potashes. As in the case of the beet-root salts, we give the names of the manufactories whence the specimens were obtained; and we here desire to thank those manufacturers who, while supplying all necessary information, have kindly authorised us to publish the composition of their products.

These results will show that commercial refined potashes contain from 69 to 93 per cent of carbonate of potash. It should be added that analyses Nos. 8 and 9 were performed upon carbonate of potassium from Stassfurt, according to the method of M. Leblanc.

(To be continued.)

PRELIMINARY NOTE ON

THE PRODUCTS OF THE DESTRUCTIVE DISTILLATION OF RESIN.

By THOMAS ANDERSON, M.D., F.R.S.E., F.C.S.,
Professor of Chemistry in the University of Glasgow.

I HAVE been engaged for several years in the investigation of the distillation products of resin. The subject having proved one of great extent and complexity, it was not my intention to have made any part of it public until it was more complete than it is at the present moment, but the recent appearance of a similar investigation by Mr. Tichborne* has induced me to alter this intention and to publish my results, especially as some of them differ from those which he has obtained.

When common colophony is distilled, the first product is a small quantity of a volatile oil, commonly known as "rosin spirit," consisting of some products of decomposition of the resin contaminated with a portion of the essential oil originally existing in the turpentine. When this is separated, an oil is obtained which becomes more and more viscid as the distillation proceeds, and shows a gradually increasing blue fluorescence as the temperature rises, and at last a small quantity of charcoal is left in the still. When this crude resin oil is rectified, the first product is a "rosin spirit," larger in quantity and somewhat different in smell from that obtained in the first distillation. This is followed by a mixture of thick oils of high boiling point, and the last product, if kept separate, acquires, on cooling, the consistency of soft butter, or rather of a mixture of oil and butter. When this is exposed to a freezing mixture and expressed, a solid crystalline substance is left on the cloth, which, when purified, proves to be the metanaphthaline or retisterene of Pelletier and Walter.

My investigations hitherto have been mainly confined to the spirit obtained in rectifying the crude resin oil. When this is submitted to a systematic fractionated distillation, it splits up into a variety of oils, and after seven or eight rectifications, fractions are obtained at all temperatures, from 70° C. up to 400°, the latter being of course portions of the less volatile oils which passed over at the first rectification.

The fractions boiling between 125° and 150° deposit a crystalline substance, which is obviously an oxidation product, and increases in quantity when the oil is preserved in partially filled bottles. This substance is Mr. Tichborne's colophonine. It is soluble in water, ether, and alcohol, and is deposited from the hot solutions in long needle-shaped crystals, which fuse at 106° and sublime easily at a higher temperature. Their smell is aromatic, and they have a warm and somewhat pungent taste. They were purified by expression, exposure to the air until the oil attached to them had evaporated, and then subliming repeatedly. The results of combustion were as follows:—

(I.) 0·425 gramme gave 1·004 CO_2 and 0·424 H_2O.
(II.) 0·2225 gramme gave 0·526 CO_2 and 0·225 H_2O.

* CHEMICAL NEWS, vol. xx., p. 38.

	I.	II.	Calculation.	
Carbon	64·43	64·47	64·61	C_7 84
Hydrogen	11·09	11·24	10·77	H_{14} 14
Oxygen			24·62	O_2 32
			100·00	130

This corresponds completely with the empirical formula $C_7H_{14}O_2$ which bears a simple relation to terebic acid, $C_7H_{10}O_4$. I have endeavoured, but as yet without success, to convert this substance into terebic acid by means of oxidising agents. By strong nitric acid it is converted into oxalic acid, with more dilute acid a resin is produced, but I have not obtained it in sufficient quantity to admit of any process of purification being applied to it. Not having analysed the crystals of this substance deposited from water, I failed to detect Mr. Tichborne's hydrate of colophonine, but the composition he gives for it is not altogether inconsistent with my formula, for a hydrate $C_7H_{14}O_2+H_2O$ would give—

Carbon	56·75
Hydrogen	10·81

The oils contained in resin spirit are very complex, and consist of a mixture of hydrocarbons, the investigation of which is still quite incomplete. The most volatile fraction, which was very small and boiled between 70° and 80°, contained a volatile acid, apparently acetic acid, which gave abundant white fumes with ammonia. After separation of this acid by washing with water and drying, the oil gave—

Carbon	84·62
Hydrogen	13·71

Though the oil obviously contains oxygen, these numbers approximate to the composition of an olefiant, and its vapour density was 3·257, agreeing sufficiently with 3·386, which is the theoretical number for heptylene. The oil is probably a mixture of this substance with some oxygenated product, but the quantity at my disposal did not permit of any process of separation being employed.

At the temperature of 107° a larger quantity of oil was obtained, also containing oxygen. It gave, on combustion—

	I.	II.
Carbon	85·90	86·44
Hydrogen	12·75	12·97
	98·65	99·41

in which the carbon agrees with that of an olefiant, although the hydrogen is deficient. As far as analysis is concerned, the oil appears to be homogeneous, for, on rectifying it and separating the first few drops and the last few drops of the distillate, they were found, on combustion, to give identical results. The action of reagents, however, leads to an opposite conclusion. When digested for some time at 220° with strong hydriodic acid, it is converted into a black oil heavier than water. This, after being washed with potash and dried, yielded on distillation two oils, one boiling at about 177°, which contains iodine, is partially decomposed by distillation, and for which no formula could be obtained, and a non-iodised oil, very viscous, with a green fluorescence, and boiling a 290°. On combustion, it gave the following results:—

	Experiment.	Calculation.	
Carbon	87·94	88·24	C_{10} 120
Hydrogen	12·19	17·76	H_{16} 16
	100·03	100·00	136

It is therefore a terpene apparently corresponding with the colophene or metaterpene of Berthelot.

Of the less volatile oils, I have as yet examined only one boiling at 157°, and another boiling at a higher temperature. The former is an oxygenated oil, with a specific gravity of 0·853. The results of its analyses in

the first instance approximated to those of terpinol, with which, however, it is only isomeric and not identical. But some results afterwards obtained lead me to suspect that it may be a product of hydration of a terpene existing in the crude oil. When treated with sulphuric acid, heat is evolved, and the oil, after being separated from the acid and purified by distillation, has exactly the smell and composition of terebene. The products at higher boiling points appear to be terpenes, but they give no solid hydrochlorates, and their separation presents difficulties which I have not hitherto been able to overcome.

I trust I may be able at some future period to throw further light on the constitution of these substances; my investigation of which must be considered for the present as entirely preliminary.

ON THE

ESTIMATION OF THE SO-CALLED PRECIPITATED PHOSPHATES IN MANURES,

AND THE

ESTIMATION OF SOLUBLE PHOSPHATES GENERALLY.

By FRANCIS SUTTON, F.C.S., Norwich.

THE difficulty presented by this subject has lately been discussed in this journal from two points of view, namely, that of the manure manufacturer and the professional analyst.

Anyone who knows anything of the matter must certainly feel, with the manufacturer, that it is a real grievance to have expended time and money in producing soluble phosphate which, owing to this reducing action, is valued at only about one-third the price it ought to sell for.

Again, on the other hand, the analyst is asked to say how much phosphate of lime soluble in water is present in a particular sample of manure, and his duty is plainly to treat such a sample with water only, and state the percentage of phosphate therein.

The manufacturer says, I believe the recently-reduced phosphate is quite as effectual in action as the soluble phosphate, because I am told by good authorities that, so soon as soluble phosphates come in contact with the soil, they are rendered insoluble, and, therefore, why should not my recently-precipitated phosphates be just as valuable as the soluble phosphates? The only reply that can be made to this is that the analyst, unless he can find a reliable process for estimating recently-reduced phosphates, must consider and value them solely as insoluble phosphates. It has been proposed to use citric acid, oxalic acid, or oxalate of ammonia for the purpose of rendering these phosphates soluble, in order that they may be estimated and valued at a higher price than ordinary insoluble phosphates.

If it can be shown that any of these reagents will affect such a material as Cambridge coprolite, and render it soluble in water, it is manifest that such aids cannot be depended upon for the purpose required.

This seems to have been pretty well settled by the experiments of Mr. Hughes; but the results obtained by him have been cavilled at by one of your correspondents ("Fair Play") as being conducted in an improper way. As I am situated in the heart of a large manure-consuming district, and continually estimating phosphates, it has occurred to me to extend these experiments somewhat further, and I think the result will show that no real dependance can possibly be placed upon any of the hitherto-suggested plans for determining these reduced phosphates.

The experiments were made upon two substances, namely, a mineral superphosphate which originally contained about 23 per cent of soluble phosphate (calculated as bone-earth), but which, at the time of the first experiment, yielded only between 17 and 18 per cent, together with about 10 per cent of insoluble; the other substance was raw Cambridge coprolite, containing about 56 per cent of insoluble phosphate of lime. All the determinations were made by the acetate of uranium process, in the presence of a slight excess of free acetic acid.

1. One grm. superphosphate, treated first with cold and afterwards with hot water, yielded 17·7 per cent soluble phosphate.

2. One grm. finely-ground coprolite, treated precisely in same manner (as might be expected), gave no soluble phosphate.

3. Residue of No. 1, boiled with 100 c.c. water and 4 c.c. strong acetic acid, yielded 2·3 per cent soluble phosphate.

4. One grm. coprolite, with same proportions of water and acetic acid, gave 4·8 per cent soluble.

5. One grm. of the superphosphate, heated with equal parts of acetic acid and water, gave 19·5 per cent soluble.

6. One grm. coprolite, treated in same manner, gave 9·9 per cent soluble.

7. One grm. coprolite, heated with 1 grm. citric acid and 100 c.c. water, gave 10·4 per cent soluble.

8. One grm. coprolite, with same quantities of tartaric acid and water, gave 10·8 per cent soluble.

9. One grm. of same superphosphate, digested in the cold with ½ litre of water for twelve hours, gave 14·8 per cent soluble.

10. One grm. of the same superphosphate, but some five or six weeks older, was put into a vessel with ½ a litre of water, and charged with 10 volumes of carbonic acid for five hours; the yield was 13·8 per cent soluble.

11. One grm. coprolite was treated precisely in same manner, and gave slight traces only of soluble phosphate.

12. 2·5 grms. same superphosphate, digested in the cold with 2·5 grms. oxalate of ammonia in ½ litre of water for twelve hours, gave 16·0 per cent soluble.

13. 2·5 grms. coprolite, digested in the cold with same weight of oxalate in ½ litre of water for twelve hours, gave no soluble phosphate.

14. 2·5 grms. superphosphate and 2·5 grms. oxalate of ammonia were mixed with ½ litre water, and heated on the water bath one hour; the yield was 17·1 per cent.

15. One grm. superphosphate, with 1 grm. oxalate, were mixed with 50 c.c. water, and digested half an hour on water-bath; the yield was 19·4 per cent soluble.

16. Same weights of both were mixed with 50 c.c. water, and digested in the cold twelve hours; the yield was 17·6 per cent soluble.

17. One grm. superphosphate, with 1 grm. oxalate, were mixed with 50 c.c. water, and boiled ten minutes; the yield was 22·6 per cent soluble.

18. One grm. coprolite, boiled for same time in 50 c.c. water and 1 grm. oxalate, gave 10·8 per cent soluble.

The results of these experiments are, in some respects, anomalous, but a little consideration will probably throw some light on the matter.

The superphosphate here examined contained considerable quantities both of iron and alumina; and it seems that it is only such phosphates that are, to any considerable extent, liable to this reduction. The true explanation of their action in this respect I cannot pretend to give, nor have I heard of any being given by others; it is, however, well known that raw phosphates containing these substances make very soft and pasty manures, which, before they can be rendered marketable, must be dried by the addition of some absorbing substance which, as it removes the constitutional water from the iron or alumina phosphates, converts them into some basic form which is not soluble in plain water. If it be the case that iron or alumina, or both, are at the bottom of this matter, this explains the slight effect which acetic acid has upon the residue of this particular superphosphate after exhaustion with water (see experiments 3 and 5); while the plain coprolite, containing only slight traces of iron or alumina, yields double the percentage of soluble phosphate under the same treatment in experiment 4, and about five times as much in experiment 6.

With regard to the effect which oxalate of ammonia has upon reduced phosphates, it appears that no very great increase of soluble phosphate is obtained by dilute solutions in the cold, nor upon coprolite; but when a boiling heat is used, and the solution concentrated, a considerable yield is obtained in the case of the reduced phosphates, and as much as 10·8 per cent from the coprolite.

It does, therefore, appear that, where a superphosphate contains the so-called reduced phosphates, their amount may pretty nearly be found by the use of oxalate of ammonia in a boiling solution. But it is quite another question whether the phosphates so recovered are as valuable as if they were soluble in water; at any rate, carbonic acid, under considerable pressure, has no more effect upon them than it has upon raw coprolite. The thing which does affect them, namely, oxalic acid, acts upon hard raw coprolite still more; and this does not favour the supposition that they are as valuable as if they had never been reduced.

Again, suppose a manufacturer chooses to mix off some tolerably pure form of insoluble phosphate with a superphosphate liable to reduction; the analyst who used the oxalate process for estimation would, probably, report several per cents of soluble phosphate in the manure which had never been in the soluble state at all, and the farmer would be asked to pay about three times as much for such phosphates as he might have bought them for in the form of coprolite.

Under such circumstances as these, it, therefore, seems that the duty of the analyst is plainly to state the absolute truth—namely, that such a sample of manure contains so much phosphate of lime soluble in water—and there leave it. I repeat that this is a hardship to the maker, in many cases; but I am not certain that it is necessary for him to incur this risk.

I would now say a word or two relative to the method of estimating soluble phosphates; the stigma which has been brought upon professional chemists in general by the fact that some well-known professional men invariably give high results, while others, also, invariably give low ones, is considerable, and ought, if possible, to be removed.

This discrepancy may, in most cases, be accounted for by the process adopted in determining the phosphates; and, in order to remedy this evil, I would recommend the universal use of one process only, granting that a good and reliable process can be found.

All chemists are aware of the good effect which has resulted from the adoption of this system in silver assaying by the wet method and others of like nature; and I see no reason why it should not be adopted in the matter of soluble phosphates. There may, of course, be a difference of opinion as to what process shall be adopted, but I know of none so reliable for manures of all descriptions (for soluble phosphates), as the uranium process by weight (fully described by me in this journal of February 4th and 18th, 1860). A very large number of analyses made in my laboratary since that time, and tested by every conceivable comparison, have brought the conviction that no other process is, at the same time, so short and so exact, and is quite available, without modification, in the presence of iron or alumina phosphates usually found in some samples of manure. An analysis can be begun and completed within three hours; and, of course, a series may be carried on at one and the same time, if a sufficient number of vessels are at hand. The objection against the process, on the ground of expense, amounts to nothing, since the whole of the uranium can be recovered again for repeated use.

To Melt Two Metallic Mixtures by Friction.—Melt, in one vessel, one part of mercury and two parts of bismuth; and in another one part of mercury and four of lead. When cold, they will be quite solid, but, by rubbing them against each other, they will soon melt, as if each had been rubbed separately against red-hot iron.—*American Artisan.*

DETECTION OF POTASH AND SODA BY BLOWPIPE VESICULATION.

THE following letter and list of experiments has been forwarded by Capt. W. A. Ross, R.A., to Professor Theodore von Richter, Head of the Royal College of Freiburg, and also to us for publication in the CHEMICAL NEWS:—

Simla, India, June 17th, 1869.

Dear Sir,—In accordance with the request contained in your letter of the 1st of January, 1868, to my address at Woolwich, to be informed of the result of my further labours in the matter of blowpipe vesiculation discovered by me, I have the pleasure now to communicate the following:—On arriving here in April, the weather being very warm and dry, and an aneroid barometer compensated for heat standing only at 22·80°, I made some borax vesicles of KOHO and CaCl, and other of the most deliquescent salts I had, none of which, to my surprise, either deliquesced or showed the least sign of crystallisation. They remained unchanged until the 8th of June, when very heavy rain fell the whole day and night. Next morning the potash vesicle had partly deliquesced, and the rest were covered with crystals. From this fact I ascertained that the vesicular crystallisations of borax discovered by me are all superposed, or formed from the hygrometric moisture of the air, and not pyrogenous, or formed from the hot borax on cooling, like those mentioned by Berzelius (pp. 64, 190, 214, &c., of the American Translation, Boston, 1845), Rose of Berlin, and other writers. As it appeared to me that the moist atmosphere could only act with uniformity on uniformly composed substances presented to it for crystallisation, I strove to attain something like uniformity by measuring 50 milligrammes of borax for each bead, taking up as near as possible an equal quantity in each case of the substance to be examined. I found this a troublesome process, and hit upon a far easier and equally exact method—by measuring the bead after it had cooled, by slipping over it a glass tube of the diameter of 5° on the lead measure, filing a shoulder on the top of the platinum wire holder to allow the tube to stand upright over the wire, and then seeing with the magnifying glass how far the sides of the bead (placed with the wire next the eye) were from touching the sides of the tube. I reflected, however, that borax, being a compound salt, could scarcely be expected to give uniform results chemically, either as regards crystallisation or any other operation, and connecting the fact in my mind that alkalies and alkaline earths always give a cloudiness to vesicles of borax in moist weather with the other facts—(1) that the "boron diamond" can only be attacked by the fused hydrates of the alkalies; and (2) that alkaline borates are freely soluble, while those of the other bases are either insoluble or very sparingly so—I determined to operate if possible on pure boracic acid. I was much pleased to find that substance easily blown into vesicles (having expected the contrary), as it is very viscid when the HO and air bubbles are expelled from it, and I found that its vesicles, being thinner than those of borax, invariably possessed a most brilliant iridescence. But the most useful feature to me was the fact of their clouding over a few seconds after formation, with a delicate blue white film upon which the iridescent colours, gleaming beneath, bestowed a beautiful opaline or mother-of-pearl lustre which I have called "opalescence." I immediately saw that as the borax vesicle is clear and the boracic acid one opaline, a valuable and sure means of detecting the presence of soda, at least in the proportion in which it enters into the composition of borax, is thus afforded, for that amount of soda in the subject of analysis would of course combine with the BO_3 forming a boracic acid (or clear) vesicle. I will not fatigue you with details of the experiments I made, 48 of which I have the pleasure to enclose. You will be able to draw just conclusions from them or others repeated far better than

I can possibly do, but I may venture to state that my object hitherto has been almost exclusively confined to a means of isolating, by this method, potash from soda, the blowpipe flame and oxide of nickel tests being, as you are aware, almost worthless, and that, by the wet analyses, a long, tedious, and difficult operation. Without troubling you with details (which will be found in the experiments), I ventured to conclude—

1st. That soda and fluor spar (CaF) interfere with the opalescence of BO_3 vesicles.

2nd. That potash does not interfere with it.

3rd. That chlorine increases it both as to quickness of appearance and intensity.

4th. That CO_2 causes it to appear after a time weakly, even in the presence of soda.

I regret I have no pure or caustic soda to operate with, nor can I obtain it nearer than Calcutta. Experiments 17 and 20 show that 10 to 13 c.c. of potash Alaunstein can be detected by this method in presence of 53Fl and 32 soda (in kryolite), and, on the other hand, experiment 48 shows that, without soda as a constituent, potash alone fails to neutralise the effect of CaF in preventing the opalescence of vesicles of boracic acid.

I have, as you will see, attempted scarcely anything but the two alkalies—the acids and metals, &c., remaining for future examination. It was easy enough to distinguish by this method between potash and soda in pure salts, but I found it more difficult when applied to traces of those alkalies in silicates; still, I discovered, as you will see, traces of potash by this means in the soda minerals, "albite, analcine, and labradorite," supplied me from Freiberg, while kryolite showed not a trace, and when artificially supplied with KO from Alaunstein, immediately showed a strong trace of that alkali.

Besides being (I hope) found to be most useful in detecting soda and potash in minerals, and of making BO_3 and CaF betray each other, these boracic acid vesicles form the most delicate hygrometers possible, clouding over with a rapidity proportional to the amount of moisture contained in the atmosphere. If the air is so very dry that even boracic acid vesicles take some time to opalesce, the addition of chlorine will make them still more sensitive, and if the air is very moist, that of CaF far less so, until absolute insensibility (or transparency) is attained. I regret that the departure to-day of the mail prevents my saying more at present on this interesting subject. Pray let me know what results your experiments on the subject give, and believe me, yours with great respect,

W. A. Ross.

EXPERIMENTS IN VESICULATION WITH BORACIC ACID, JUNE 13, 1869.
(Bar. 22·70; Ther. 82; Air, very dry).

1. BO_3 + KOHO.	Opalesced in four minutes.
2. BO_3 + $NaOCO_2$.	Remained quite clear for hours.
3. BO_3 + $KOCO_2$.	Opalesced in fifteen minutes.
4*a*. BO_3 + NaCl.—At first I took a large quantity of BO_3, and could not take enough Na from the NaCl to satisfy it, as the bead dropped off.	The BO_3 therefore apparently seized upon a part of the Cl (which came off in thick fumes) and the vesicle clouded over the moment it was taken from the flame.
4*b*. Tried NaCl again, in large quantity, with very little BO_3.	Fumes of Cl, when stopped vesicle made; remained quite clear ever since up to to-day (June 17).
5. BO_3 + MoS.—The native sulphide.	Clouded (not opalesced) in quarter of an hour; afterwards crystals formed exactly like leopards' spots.
6. Tried 4*a* and 1 near the flame of spirit lamp.	Opalescence vanished immediately, leaving a clear dry vesicle exactly like the volatilisation of the sublimate of arsenic from charcoal before the blowpipe.
7. Alaunstein.	Opalesced in fifteen minutes.
8. Kryolite.	Remained quite clear to date; vesicle much less fragile and iridescent than those of BO_3, and bead more fluid.
9. Adular.	Opalesced slightly in twenty minutes.
10. Albite.	Faint opalescence after quarter of an hour.
11. SiO_2 powdered.	The SiO_2 remained undissolved; the BO_3 opalesced strongly after quarter of an hour.
12. Vesiculated KOHO in borax; made a hole with pin at top, and breathed upon it.	Deliquesced rapidly and translucently on the edges of the hole, without having clouded over or opalesced in any way; crystals afterwards formed on edges of the hole.
13. Breathed upon 1 and 4*a* when freshly re-made.	Both rapidly opalesced, but when heated very gently near spirit lamp, frothed instead of vanishing.
14. Mixed 11 with a little kryolite.	Opalesced slightly.
15. Mixed ditto with NaCl, driving off the Cl well, as I did not think it had Na enough.	Remained quite clear to date (17th).
16. Analcim.	Very difficult to make; opalesced faintly in quarter of an hour.
17. Ditto, with CaF.	Remained quite clear to date.
18. Labradorite.	Opalesced pretty strongly in twenty minutes.
19. Ditto with CaF.	Remained quite clear to date.
20. Mixed 7 and 8.	Opalesced pretty strongly.
21. „ 7 with CaF.	Remained quite clear all night.
22. „ 9 „ „	„ „ „
23. „ 10 „ „	„ „ „
24. Re-made 12 and added BO_3.	Remained clear for twenty-five minutes.
25. Re-made 1 and added $NaOCO_2$.	Opalesced faintly in quarter of an hour.
26. Re-made 21, 22, and 23, and added KOHO to each in large quantity.	Remained quite clear to date.
27. Pure boracic acid.	Opalesced round platinum wire in thirty seconds.
28. Re-made 4*a* and 1 fresh.	Opalesced in a few seconds 4*a* quickest.
29. Re-made 20 and added $NaOCO_2$.	Remained quite clear to date.

30. Added BO_3 to 24.	Remained clear for twenty minutes.
31. Added $NaOCO_2$ to 25.	Opalesced very faintly in quarter of an hour at one end only.
32. Added more $NaOCO_2$ to ditto.	Remained quite clear to date.
33. Added much BO_3 to 30.	Bead very fluid; opalesced in quarter of an hour.
34. Re-made 27.	Opalesced slightly in one minute; all over in twenty minutes.
35. Added NaCl to much BO_3.	Began to opalesce in thirty seconds; completely opalesced in two and a half minutes.
36. Added more NaCl to ditto.	Remained quite clear.
37. BO_3 + CaCl to saturation.	No Cl disengaged; vesicle clouded mechanically with Ca.
38. BO_3 + very little CaCl.	Opalesced in one minute, but did not increase.
39. Pure boracic acid.	Opalesced slightly in half a minute; all over in five minutes.
40. Re-wetted 37 with geblase.	Bead opaque; vesicle opalesced in ten minutes.
41. BO_3 with slight trace CaF.	Opalesced in quarter of an hour.
42. The same with double CaF.	Remained quite clear to date.
43. BO_3 with trace CaF.	Opalesced in quarter of an hour.
44. Pure boracic acid.	Opalesced slightly in half a minute; all over in three minutes.
45. $NaOCO_2$ (sub-carbonate).	Opalesced slightly in ten minutes.
46. ,, (double quantity).	Opalesced considerably in quarter of an hour.
47. ,, (more $NaCO_3$).	Remained clear to date.
48. Added KOHO to 42.	,, ,, ,,

MISCELLANEOUS.

British Pharmaceutical Conference.—The meeting for the present year will be held during the third week in August, at Exeter, in the College Hall, under the Presidency of Mr. Daniel Hanbury, F.R.S. On Tuesday, the 17th, at 10 a.m., the President will deliver an address; the reading and discussion of papers on pharmaceutical subjects will then commence, be continued in the afternoon till 4.30, and be carried on during Wednesday; an adjournment from 12.30 till 2.0 taking place each day. On Thursday a complimentary entertainment to their visitors will be given by the chemists of Exeter. On Friday, the chemists of Torquay invite members to view some points of interest in the neighbourhood and partake of luncheon.

University of London.—The following are lists of the candidates who have passed the recent examinations in Arts and Science. *First B.Sc. Examination* (*Pass Examination*).—First Division. Edward Bibbins Aveling, University College; Walter W. Rouse Ball (First B.A.), University College; Henry Septimus Bott, Owens College; Frank Clowes, Royal College of Chemistry and Pr. st.; John William Elwes, King's College; Thomas Oliver Harding, B.A. University College; Marcus Manuel Hartog, University College; Charles William Hodson, Chester College; David Bridge Lees, B.A. Camb., Owens and Trinity College, Cambridge; Robert Routledge, Owens College. Second Division. Hampden Gurney Jameson, University College; Sidney Follett Osler, University College; Charles Rigg, Chester College; Robert Davies Roberts, University College.

The Metric System of Weights and Measures.—The second report of the Standards Commission has just been published, together with an appendix of detailed information. The Commissioners confine themselves in this report to the questions connected with the metric system, and with its adoption in the United Kingdom; and they consider the reasons for and against its introduction under two heads—namely, those which relate to the internal commercial transactions of the country; and those which relate to transactions with other countries. With regard to the former, they observe that there is at present no inconvenience arising from the discordance between the customary weights and measures, because, whatever difference may prevail as to the multiples in local use, the essential units—the yard, the pound, and the gallon—are everywhere the same; based upon standards which are constructed with the utmost skill and care, and supported by a system of inspection which, though chargeable with imperfections, is, on the whole, efficient. Moreover, the requirements of different trades need somewhat different bases. The yard is a very convenient length for draper's measures, but the foot is far more convenient for carpenter's measure. It has been remarked that the last, or coomb, the bushel, and the peck, are well suited for men's backs, arms, and hands; and also that the natural inclination of the mind to halve and quarter continually exhibits itself in the subdivision of almost every base. The metric system does not offer facilities either for the change of the adopted base, or for the continued binary subdivision; and any attempt to force it into use in shops and into workmen's operations and accounts would propably be felt as a needless grievance. At the same time the want of weights and measures on a decimal scale generally, or on the metric scale specifically, is not unfrequently felt by the manufacturing and trading classes, and more especially by men of science and by chemists and engineers of the highest class; and it appears hardly possible to satisfy this want except by the legal establishment of metric standards, and by the legal sanction of the use of metric weights and measures in shops and offices of conveyance. In order to prevent confusion, it would be necessary to provide that the metric weights and measures should have such form or other characteristics as would render it impossible to mistake them for those of the existing system; and in a future report the Commissioners promise to deal with the question of further simplification by the abolition of troy weight. Passing on to our transactions with foreign countries, the Commissioners remark upon the recent great increase in the amount of these transactions, and argue from it to the permissive adoption of the system which agrees with that of so many of our foreign trade correspondents, as well as to the giving the ordinary statistical publications relating to trade on the metric as well as on the imperial system. Attention is next called to the degree in which the introduction of a decimal system of coinage would assist in rendering the public familiar with the use of decimal weights and measures; and the report concludes by recommendations arranged under nine heads. These recommendations are, in substance, that metric standards under the French nomenclature should be legalised and provided, but that the use of the system should be entirely permissive, and not even in prospect compulsory; that regulations should be adopted to prevent confusion between the two classes of weights and measures; that Customs and other duties might be levied and the business of public departments conducted by either system; that mural standards of both systems should be exhibited in public places; and that the decimalisation of our system of coinage should be undertaken by the Government. At the same time it appears to the Commissioners to be essential that any measure for the introduction of the metric system should be proposed to Parliament by the Executive Government; and, considering that the Commission will shortly enter upon the questions referred to, those relating to the system of local inspection of weights and measures throughout the United Kingdom, its members are of

opinion that "it is expedient that no legislation should take place with respect to the metric system until the whole subject of the weights and measures of this kingdom be brought before Parliament in one Bill."

The British Association.—Great preparations are being made at Exeter for the reception of the British Association next week. A new hall has just been completed capable of holding 2000 persons. The new wing of the Albert Museum is also finished. Various excursions are organised; and altogether the association week is expected to be very successful. The President-elect, Professor Stokes, is to be the guest of Lord Devon, at Powderham, where there will be several other distinguished guests. Lady Rolle will likewise receive a number at Bicton. Lord Clifford will receive the Abbé Moigno. Sir Stafford Northcote will entertain, at Pynes, Lord Fortescue, Lord Stanley, M.P., Lord Houghton, Lord and Lady Colchester, Sir C. Trevelyan, Mr. Baring, and others. Sir Henry Ferguson Davie will have staying with him, at Creedy, Col. Sykes, M.P., Mr. D. Dalrymple, M.P., Professor Newton, Professor Lawson, &c. At Claremont, Sir John Bowring will entertain Professor Huxley and several distinguished foreigners. The order of proceedings starts with a general meeting of the council and committees of sections of the association on Wednesday, the 18th inst., when the committees and officers of the various sections will be appointed. On the same evening, the President, Professor Stokes, will deliver the inaugural address at the new Victoria Hall. On the following day, the presidents of the seven sections will deliver their addresses, and the reading of the papers will commence. A *soirée* will be held on Thursday evening in the Museum. On Friday evening, Professor Phillips, D.C.L., F.R.S., will lecture on Vesuvius. Saturday will be slack in the sections, as there are to be two excursions on that day—one to the extreme west, and the other to the extreme east of the county; but in the evening Professor Miller will deliver his lecture to the operative classes in the Victoria Hall. As it is intended for working men and their families, the price for admission is fixed at 2d., and it is fully expected that there will be very numerous applications for tickets. On Monday, the sectional meetings will be supplemented by a lecture on the sun, to be delivered in the Victoria Hall by Mr. Norman Lockyer. The sections will resume work on the Tuesday; and on Wednesday, the 26th, the British Association week in Exeter will terminate with the Mayor's luncheon at the Royal Public Rooms.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, vol. lxix., No. 4, July 26, 1869.

A very considerable portion of this number is again devoted to an apparently never-ending dispute about the Pascal, Newton, and Chasles-Le Verrier controversy. Among the papers we notice:—

Researches on the Products of Oxidation of the Principal Normal Alcohols.—MM. Pierre and Puchot.—The authors have used the well-known plan of acting with bichromate of potassa and sulphuric acid upon the alcohols submitted to experiment. They distinguish, among the products of this reaction, between the normal acid belonging specially to an individual alcohol, its aldehyde, and the compound ether, which are proper to each separate alcohol; for instance, with amylic alcohol, valerianate of amyl may be obtained; with butylic alcohol, butyrate of butyl may be produced. The authors describe, at great length, what precautions are in general required to be observed in experiments of this kind, and then specify the following particulars:—(1) The preparation of valerianate of amyl, $C_{10}H_9O_3,C_{10}H_{10}O$, by the oxidation of amylic alcohol; (2) the preparation of butyrate of butyl, $C_8H_7O_3,C_8H_9O$; (3) the preparation of propionate of propyl, $C_6H_5O_3,C_6H_7O$. These preparations are concisely described.

Proposed Plan of Protecting Iron Vessels against Rust and Corrosion.—MM. Dance and Bertin.—The plan proposed by these gentlemen for this purpose, is to convert the hull of the iron vessel into a galvanic battery by placing, inside the hull, pipes and tanks made of zinc and filled with sea-water, and connected, by means of bolts and rivets in metallic contact, with the outer side of the vessel. The authors of this paper also propose the use of strips of zinc on the iron plates of the vessel immersed in the water.

Correlation of the Unequal Visibility of Colours at Twilight, and their Unequal Photographic Activity in Full Daylight.—M. Keller.—The author observes that, after sunset, those colours which are the brightest when seen by daylight, become very dark—for instance, red, orange, and yellow; while blue, violet, and indigo, which are less bright when seen by daylight, become whitish (*blanchâtres*) in twilight. The author further observes that, in a photographic print, the first-named colours produce black, and the last-named grey. White light, producing all vibrations, is capable of exciting all colours; but, since, according to the researches of the Rev. Father Secchi, S.J., the light of the sky after sunset is especially rich in blue rays, it need not excite astonishment that the less refrangible rays should be, as it were, extinguished.

Action of Permanganate of Potassa upon Cinchonine.—MM Caventon and Willm.—The principal products of the reaction of a very cold solution of permanganate of potassa added, *guttatim*, to a cold solution of cinchonine, slightly acidified with sulphuric acid, are:—(1) An indifferent, neutral compound, which unites with bases as well as with acids, which has been named by the authors, *cinchoténine*; (2) an acid capable of being obtained in crystals, which is named *carboxycinchonic acid*; (3) a substance which reduces the tartrate of copper and potassa. In addition to these compounds, the authors state that they have discovered, by this reaction, a new alkaloid, which is made up according to the formula $C_{30}H_{26}N_2O$, and which is named *hydrocinchonine*. This base fuses at 268°, cinchonine fusing at 257°; the former base is insoluble in water, difficultly soluble in strong alcohol at ordinary temperature, and more readily so in boiling alcohol. Cinchonétine, $C_{18}H_{20}N_2O_2$, is a solid substance, soluble in boiling water. Carboxycinchonic acid, $C_{21}H_{14}N_2O_4$, is a solid substance, pretty readily soluble in water, and obtainable in crystalline state; it is a bibasic acid which forms with alkalies and baryta very soluble salts.

August 6, 1869.

Leaving, again, the purely mathematical and physico-mathematical papers, and also the voluminous papers on the controversy about the Newton, Galileo, Le Verrier, and Chasles papers and communications, we notice the following papers:—

Laws Governing the Solution of a Substance in Two Solvents.—MM. Berthelot and Jungfleisch.—This paper is not well suited for abstraction; but the subject it treats of may be stated in a few words, while we reserve the paper for more full treatment in our pages at a future time. All chemists know that it often happens that, in order to obtain from its solution, in water, for instance, they make use of ether, or other fluids not miscible with water, to extract therefrom any substance, *e.g.*, bromine or iodine, dissolved therein; the ether thus applied acts purely by its physical properties. The authors in this paper give, at length, the results of their researches on this subject which is very ingeniously treated.

Researches on Alloys.—M. Riche.—This paper is a continuation of a series of communications on this subject by the same author. While the hardening of steel has the effect of decreasing its density, as already long since stated by M. Caron, it was thought that this same effect was produced in bronze sonorous instruments, as, for instance, the Chinese gongs. The author finds that hardening and annealing are two operations the effect of which is totally different for steel and for bronze; whilst hardening has the effect of decreasing the density of the former, it increases that of the latter; annealing, on the other hand, increases the density of steel, and decreases the density of hardened bronze. Copper, repeatedly hardened and annealed, does not perceptibly vary in density.

A New Pyrometer.—M. Lamy.—The author proposes to use pure Iceland spar, basing the use of this substance, as a pyrometer, upon the law of dissociation.

Synthesis of Glucosides.—M. Schützenberger.—We reserve this paper for full translation in our columns.

Action of Anhydrous Sulphuric Acid upon Perchloride of Carbon.—M. Schützenberger.—When in perchloride of carbon, CCl_4, anhydrous sulphuric acid is dissolved, there is instantaneously observed a smell of phosgen gas, and when the solution is heated upon a water-bath, chloroxycarbonic gas is regularly given off. When this evolution of gas ceases, there remains in the retort a fuming liquid, which, on being submitted to distillation, yields, at about 75°, the excess of perchloride of carbon; next, the thermometer rises to 130°, and at that

temperature nearly the whole of the liquid distils off. The distillate is a colourless liquid, fuming in the air, and, on contact with water, instantly decomposed into hydrochloric and sulphuric acids; on being analysed, this liquid yields results leading to the formula, $S_2O_3Cl_2$, that is, an oxychloride of sulphur. The action of anhydrous sulphuric acid upon perchloride of carbon can, therefore, be represented by—

$$S_2O_6 + CCl_4 = S_2O_3Cl_2 + CCl_2O.$$

Gases Given Off by Fruit.—MM. Lechartier and Bellamy.—The authors prove, in this paper, that various kinds of fruit, after having been plucked from the trees—for instance, apples, cherries, gooseberries, and currants—begin to absorb oxygen and give off carbonic acid. The paper enters into lengthy quantitative details on this subject; as a proof that the quantity of carbonic acid given off by large quantities of fruit, say apples, for instance, stored up, may be considerable; suffice it to notice that five apples, weighing together 348 grms., yielded, from the 19th of January last up to the 15th of July last, 6648 c.c. of carbonic acid gas.

New Synthetical Method for the Preparation of Naphthalin-carboxylic Acid.—M. Eghis.—The author mixes monobromide of naphthaline, chloroxycarbonic ether, and sodium amalgam; and, after a complicated set of operations and purifications, obtains, as result, a solid substance, readily soluble in alcohol, ether, and boiling water, fusing at 160°, and yielding, on elementary organic analysis, results leading to the formula $C_{11}H_8O_2$. An identical substance was obtained by Prof. A. W. Hofmann, from cyanide of naphthaline derived from oxalate of naphthylamine; the body here in question was named by the last-named *savant*, menapthoxylic acid, or naphthalin-carboxylic acid.

Cosmos, July 31, 1869.

We quote from this paper a brief account of—

The Rio Vinagre.—This river has its source at a height of 3500 metres above sea level, near a very difficultly accessible spot of the volcano named the Puracé. The late Alexander von Humboldt first ascertained that the water of this river contains free sulphuric and hydrochloric acids. According to M. Boussingault, this river discharges into the Rio Cauca, wherein it falls from a height of 125 metres, during every twenty-four hours, 34,784 cubic metres of water, containing 37,611 kilos. of strong sulphuric acid, and 31,654 kilos. of concentrated hydrochloric acid. The Rio Cauca, after having received the waters of the first-named river, does not feed any fish for a distance of 18 kilometers of its seaward course. The volcano Puracé is not provided with a crater, as ordinarily met with on volcanoes, but its main outlet is a longitudinal split, 2 metres in length by 1 in width; it is covered at the top with a layer of very pure sulphur of about half a metre thick. There is at all times a strong escape of gases and vapours from the main outlet of this curious trachytic mountain, accompanied by a loud noise akin to that of the blowing off of the steam of several large high pressure steam-boilers. In the island of Java there are several rivulets and small lakes also containing free sulphuric and hydrochloric acids; while in one locality on the island of Sumatra, a lake is met with which contains free nitric acid. All these phenomena are caused by active volcanic action.

The American Journal of Science and Arts, No. 141, May, 1869.

We notice from this periodical the following original papers, omitting such as relate to astronomy, mathematics, and mechanical science:—

Atomic Volumes of the Elements.—M. Frank Wigglesworth Clarke, S.B.—This is a continuation of an essay on this subject from former numbers of this periodical. The author says, in his introduction to this part:—"In a recent paper in this journal I called attention to some remarkable relations which seem to exist between the atomic volumes of certain elements in the liquid condition. Since that time, I have found similar relations between the same elements in solid state, and also between the atomic volumes of some other solid elements, of which no liquid compounds are known. A few relations between the atomic volumes of different metals have been previously observed; chief of these, we find the equality of the atomic volumes of the metals of the iron group, the similar equality connecting the platinum metals, the equality between silver and gold, and that between molybdenum and tungsten. But, as far as I have been able to learn, nothing seems to have been done towards studying the more remarkable multiple relations which connect the members of certain natural groups together." The author next proceeds to the review of the alkaline metals, quoting the specific gravities as follows:—Lithium, 0·589; sodium, 0·972; potassium, 0·865; rubidium, 1·52. Upon dividing the atomic weights of the four metals, by these specific gravities, we get, as their atomic volumes, respectively, the numbers 11·9, 23·7, 45·1, and 56·2. It will be at once seen that the three highest of these values are very nearly multiples by whole numbers of the lowest. The author reviews, next, the oxygen group, oxygen, sulphur, selenium, and tellurium; after this, the nitrogen group, the carbon group, and metals. The very brief sketch given here may, perhaps, be followed by a more full and extended abstract in our journal afterwards.

On some Minerals from Newlin Township, Chester Co., Penn.—S. P. Sharples.—The first mineral described is *Diaspore*, containing, in 100 parts:—Silica, 43·56; alumina, 38·16; water, 5·64; potassa, 10·81. Specific gravity, 2·87. Colour varies from white to greenish or yellowish; it fuses before blowpipe-flame with extreme difficulty, forming a white enamel. *Lesleyite.*—Colour, white to reddish; hardness, about three; streak, white; before blowpipe flame, loses water; does not fuse with borax; does not dissolve in hydrochloric acid; is specifically heavier than quartz, its specific gravit being 3·203. It contains, in 100 parts:—Silica, 33·59; alumina, 55·41; potassa, 7·43; water, 4·30. *Pattersonite* contains in 100 parts:—Silica, 30·20; peroxide of iron, 14·88; alumina, 20·55; magnesia, 1·28; potassa, 11·35; water, 11·73.

Note upon the Origin of the Phosphatic Formation.—C. U. Shepard, sen.—The formation here alluded to is a very extensive one found in Southern Carolina. The paper is entirely of geological interest only.

On some Derivatives of Trichlormethyl-sulphon-Chlorid, $(CCl_3)SO_2Cl$.—M. O. Loew.—This paper will be given *in extenso* in our next number.

Notes on the Occurrence and Composition of the Nodular Phosphates of South Carolina.—C. U. Shepard, jun.—It appears that the specific gravity of this phosphatic mineral varies from 1·94 to 2·54; the quantity of water varies from 5·60 to 9·15; carbonic acid varies from 2·55 to 6·62; sulphuric acid, from 1·8 to 8·7; phosphoric acid, from 24·95 to 30·17, all in 100 parts. The mineral contains, besides lime, alumina, oxide of iron, magnesia; sand, varying from 4 to 15·7 per cent; and traces of chlorine, fluorine, and sodium. The author adds the analysis of the water of an artesian well, at Charlestown, S.C. This well is 1250 feet deep; the temperature of the water at the spout is 87° F. Specific gravity of the water, at 15°, is 1·0015; the amount of solid ingredients in the water=0·228 to 0·234 per cent. In 100 parts of solid ingredients are found:—Bicarbonate of soda, 52·749; chloride of sodium, 47·051; bicarbonate of lime, 0·0883; bicarbonate of magnesia, 0·01375; silica, 0·00102; phosphates of lime, iron, and alumina, 0·0004; organic matter, 0·0017. In 100 imperial gallons of this water at 15° are contained about 1¼ lbs. of bicarbonate of soda, and 1¼ lbs. of common salt.

Certain Phenomena of Transmitted and Diffused Light.—Carey Lea.

The Cohahuila (Mexico) Meteoric Irons of 1868.—Mr. J. Lawrence Smith.—It appears that the region of Mexico bordering on Texas has been most profusely furnished with these celestial visitors; six masses, weighing, respectively, 290, 430, 438, 550, 580, and 654 lbs., have been brought to the United States. They are irregular compact masses, without any evidence of stony minerals; they belong to the softer irons, not difficult to cut with a saw. A sample taken from one only of these masses has been as yet submitted to research. Specific gravity, 7·692. It contains, in 100 parts:—Iron, 92·95; nickel, 6·62; cobalt, 0·48; phosphorus, 0·02; copper, a very minute quantity.

On Atomic Ratio.—Mr. Josiah P. Cooke, jun.—This paper treats on the so-called oxygen ratio used by mineralogists, and is more a mineralogical than strictly chemical paper.

Formation of Sugar in the Liver.—Dr. George F. Barker.—A physiologico-chemical essay.

This number of the periodical contains, as usual, a copious amount of scientific intelligence, but, since this is chiefly a reproduction from European prints, or is otherwise of local interest only, we do not notice it, the more so as there is nothing therein contained of interest which has not already been noticed by us in our journal.

Annalen der Physik und Chemie, von Poggendorff, No. 6, 1869.

This periodical contains the following original papers:—

Cohesion Exhibited by Rock-Salt in Different Crystallographical Directions.—Dr. Sohncke.—The author of this paper gives an account of his experiments on the resistance exhibited by rock-salt to tractive forces, applied thereto in a similar manner as is done to wood, metallic wires, and other solids. The paper is, however, not well suitable for proper abstraction with due justice to the author's labour, and could not, moreover, be well understood without the reproduction of a large number of tables.

Description of a Photometrical Method of Measurement and Comparison of the Intensity of Coloured Light.—M. C. Vierordt.—A large-sized engraved plate accompanies this paper.

Isolating Intermediate Layer (Zwischenschicht) of a Condenser.—M. W. von Bezold.—A mathematico-physical essay.

Point of Solidification of the Component Portions of Fluid Mixtures.—C. Schultz.—The author proves, by quoting a large number of instances, that, in a mixture of solid bodies which are miscible in a fluid state, without thereby calling forth chemical reactions, a return to the fluid state, may, and actually does, take place at a temperature below the melting-point of the most easily melting substance. This fluidisation takes place more readily, and with a less amount of absorption of heat, when the temperature, at the time of making the mixture, is so high that one of the component parts thereof is already fluid, as, for instance, is the case when salts are dissolved in water, or in alcohol, and when amalgams are mixed with mercury. The author of this paper records a large number of substances he has experimented upon.

Freezing Point of Water containing Gases in Solution, and on the Regelation of Ice.—M. Schultz.—The author states that, as a general rule, the point of solidification of fluids is lowered by substances dissolved therein, and that gases dissolved in fluids exercise the same effects. The fusing point of pure acetic acid is 16°; this is lowered to 15·2° when a current of carbonic acid is transmitted through this acid. That hydrochloric acid gas and ammonia gas do lower the freezing temperature of the water they are dissolved in is a well-known fact; carbonic acid and sulphurous acid gas do the same; and the author found that nitrogen, oxygen, and hydrogen gases exert, when dissolved in water, the same effect. The author records

a series of experiments made by him with the view of ascertaining the effect of an increase of pressure brought to bear upon the absorption of various gases by water, and the lowering of the freezing point of that liquid in consequence thereof. By the phenomenon of regelation is understood that property exhibited by ice of freezing together to a solid mass, when pieces of that substance are pressed together at the temperature of 0°. After quoting the opinions of Messrs. Faraday, Forbes, Thomson, and Helmholtz on this subject, the author says—When we take it for granted that regelation is the formation of ice from water anew, we must bear in mind that only pure water, or water, at least, not saturated with air, is suitable for this purpose. The author has studied the influence divers gases exert upon this phenomenon, but the description of his experiments is too lengthy to admit of further quotation.

Fluids Enclosed in Minerals.—M. Vogelsang.—This paper is an appendix to a paper on the same subject published in a former number of this periodical. The chief result of the author's researches is the fact that fluid carbonic acid is far more generally met with enclosed in large masses in stone, and that the conditions under, or during which that condensation took place, are as yet only very scantily known.

Influence which Mechanical Changes Exert upon the Capability of Magnetical Rotation of some Substances.—M. R. Lütge.—This essay is entirely of a mathematico-physical nature, and there belong to it a series of engravings, which render the paper not well suitable for abstraction.

Application of a Steel Magnet, armed with a Wire Spiral, to the Dynamo-Electrical Machine.—Dr. Sinsteden.

Improved Arrangement of Leclanché's Element, and a New Self-Acting Commutator.—Dr. Sinsteden.

On Laxmannite, a New Mineral from Beresowsk.—M. Nordenskjöld.—While making some researches on minerals containing vanquelinite, met with in the large mineralogical museum at Stockholm, the author found a mineral containing a double salt of chromic and phosphoric acids, which mineral he has named laxmannite, in honour of the late Professor Laxmann, who, while making a journey through Siberia, in the year 1773, brought back to Sweden a great number of minerals from the former country and from the Ural mountains. Laxmannite has a specific gravity of 5·77; its colour is dark olive-green; on heating, it loses a very slight amount only of water, fuses before the blowpipe-flame, yielding a blackish-coloured bead. When treated before blowpipe-flame with boracic acid and iron wire, it exhibits the well-known reaction for phosphoric acid; while, on being fused with soda and saltpetre, it exhibits the reaction for chromic acid; it is soluble in nitric and hydrochloric acids, chloride of lead being separated thereby. The formula of this mineral is—

$$(CuO,\tfrac{1}{2}H_2)_3PO_5+3(PbO,CuO)_3CrO_3;$$

and it consists, in 100 parts, of:—Oxide of lead, 61·48; oxide of copper, 13·13; chromic acid, 16·57; phosphoric acid, 7·83; water, 0·99.

Behaviour of the Iodates and Periodates when Submitted to Heat, and the Formation of the latter from Iodides by means of Peroxides.—M. C. Rammelsberg.—The author first points out a very remarkable difference between the iodate of potassa and the iodate of soda; the former salt, when heated, yields oxygen and iodide of potassium; the latter salt crystallises, containing 8·33 per cent of water, which is driven off at 150°. Various experimenters have stated that this salt always loses iodine when heated; others, again, have denied this. The author finds that, unless the iodate of soda is, previous to being heated, mixed with carbonate of soda, iodine is always set free. As regards the periodates, the author has submitted a number of them to properly-defined higher temperatures, and found that periodate of potassa remains unchanged, even at 200°, but at 300° it is entirely changed into iodate of potassa. The periodate of silver changes, at 175°, into iodate of silver; normal periodate of ammonia detonates on being strongly heated, yielding iodine, nitrogen, oxygen, ammonia, and water. The author has devoted a large portion of this paper to a record of his experiments on the action of iodine upon baryta and the peroxide of barium. Curiously enough, these researches have brought to light the fact that pure baryta is by no means so readily obtained as one might feel inclined to imagine, even though the product of the ignition of nitrate of baryta contained only very minute traces of silica and alumina. The author found that there is about 3 per cent deficiency therein, for, instead of finding Ba 89·54 per cent, he found Ba 86·36 per cent, and even less; and he is inclined to assume the existence of a compound Ba_4O_5; on treating baryta with iodine at higher temperature, compounds were obtained consisting, in 100 parts, of:—Ba, 58·6, I, 32·0; Ba, 56·8, I, 34·1; Ba, 57·0, I, 33·8. These compounds all contain oxygen, and the author gives the formula $Ba_9I_2O_4$. Peroxide of barium behaves in a similar manner with iodine.

Formation and some of the Reactions of the Periodates.—M. Philipp.—This paper is a lengthy essay on this subject, and too full of formulæ to admit of useful abstraction.

On the Krähenberg Meteorite, fallen on the 5th of May, 1869.—M. vom Rath.—It appears that, on the date just alluded to, there fell, at a small village in the Bavarian palatinate, near to Deux-Ponts, a meteoric stone, accompanied by a strong detonation. The author describes this stone at length, and also describes his method of analysis of this stone. In 100 parts, it consists of:—Chromate of iron, 0·94; sulphur, 2·25; iron, 3·47; silica, 43·29; alumina, 0·63; magnesia, 25·32; lime, 2·01; protoxide of iron, 21·06; protoxide of manganese, a trace; soda, 1·03. The specific gravity of this stone is 3·4975 at 18°. The analysis just quoted has been made after a portion of the pulverised stone had been repeatedly treated by means of a magnet to extract metallic iron and nickel; the powder thus separated by the magnet was found to consist, in 100 parts, of—Iron, 84·7; nickel, 15·3. The weight of the entire meteorite was found to be about 30 lbs.

Bulletin Mensuel de la Société Chimique de Paris, July, 1869.

This periodical contains the *procès verbaux* of the meetings of this Society, held on the 7th and 21st of May last, from which we learn that M. Silva described—

Some Compounds of Isopropyl.—The valerianate of isopropyl boils at 142°; its specific gravity, at 0°, is 0·870; and its vapour density 5·04. The author has tried to prepare trisisopropylamine; he obtained, however, a liquid exhibiting a strongly alkaline reaction, which distils over between 80° and 120°, and which the author thinks is a mixture of di- and tris-isopropylamine. By making butyrate of silver act upon iodide of isopropyl, the author obtained the butyrate of isopropyl ether, $C_4H_7O_2C_3H_7$, boiling at 128°, under a pressure of 755 m.m. The specific gravity of this fluid, at 0°, is 0·8787; its vapour density, as found by experiment, is 4·730. By causing nascent hydrogen to act upon the monochlorhydrine of the amyl-glycol, the author has obtained a product very much resembling amylic alcohol, as was discovered by analysis.

Synthesis of Glucosides.—M. Schutzenberger has tried to effect this by boiling a solution of *saligénine sodée* in benzine with triacetic glucose, which is slightly soluble in that liquid; and, by evaporating the filtrate on a water-bath, a substance was obtained which is viscous at 100° and solid when cold. This compound answers the characters of the glucosides; it is split up into glucose and salicetine, yielding then, also, acetic acid. This glucose is, however, a modification of that substance known as glucosane; its reducing power is less strong than that of ordinary glucose. The residue insoluble in benzine is entirely soluble in water, with the exception of a small quantity of resinous matter; the aqueous solution yields to ether a crystallisable compound, which possesses all the characteristics, also, of a glucoside, but does not contain acetic acid; its composition is $3C_{14}H_{22}O_9,C_6H_9O_9$.

M. Vogt stated that, while treating the chlorobenzylsulphate and chlorotolylsulphate of potassium with fusing caustic potassa, he has obtained salicylic and cresotic acids.

The following original papers are contained in this number of the above-named periodical:—

Immediate Analysis of the Divers Varieties of Carbon.—M. Berthelot.—We published in full the contents of this paper some time ago.

Comparison between the Saline Constituents of the Grease of Sheep's Wool and the Human Perspiration.—M. S. Cloëz.—In this elaborate paper, the author first reviews the researches of M. Vanquelin and M. Chevreul on this subject; he then briefly refers to M. Evrard's patent, for extracting, from the grease of sheep's wool, carbonate of potassa, which process has been brought to perfection by MM. Maumené and Rogelet, and is carried on on the large scale with success. The two last-named gentlemen, having published some scientific researches on this matter, have come to the conclusion that pure grease of sheep's wool was devoid of soda or salts of this alkali. The author of this paper proves, by a series of analyses, that although in the grease of sheep's wool potassa salts prevail, the salts of soda are not altogether absent. As instances of the composition of the saline constituents of this material, we quote, out of the large number of analyses, a couple of instances:—Grease from sheep's wool taken from animals in pasturage near the sea contained saline matter, in 100 parts, composed of—Carbonate of potassa, 84·80; sulphate of soda, 4·65; chloride of sodium, 10·45. Another sample contained, in 100 parts—Carbonate of potassa, 87·27; sulphate of potassa, 3·59; sulphate of soda, 0·68; chloride of sodium, 8·27. The saline constituents of human perspiration the author found to contain:—Carbonate of potassa, 31·82; sulphate of potassa, 11·76; chloride of potassium, 16·02; chloride of sodium, 38·54.

Relative Proportion of Alkalies found in the Ash of Divers Plants.—M. Cloëz.—This paper is a valuable addition to the methods of ash analysis of plants; but the author chiefly desires to call attention to facts observed already by the late MM. Ingenhousz, Senebier, and Johnston—namely, that the same plants grown near the sea, and at remote distances therefrom, alter their saline constituents, so that, while growing near the sea, soda prevails, as a rule, over potassa, the reverse being the case while the same plant vegetates at a distance more or less remote from the sea; of this fact, some instances are given in this paper. The relation of the soda to the potassa of the ash of *Crambe maritima*, when grown near the sea, was as 960 to 1000; when grown at Paris, as 89 to 1000. The relation of soda to potassa in the ash of black mustard seed grown near the sea was as 200 to 1000, while when grown at Paris, it was as 96 to 1000.

Supersaturation and Dissolution.—M. Lecocq de Boisbaudran.—This paper is a critical review of a paper published in the *Comptes Rendus*, and is not well suited for abstraction.

On Nucitannic Acid.—Dr. Phipson.—The author says that he has discovered, in the epispermium of walnuts, a peculiar kind of tannin, to which he has given the name of nucitannic acid or nucitannin. It is soluble in water and in alcohol; is precipitated by subacetate of lead; while its most remarkable property is that, when boiled with dilute acids, it is split up into glucose, and a reddish-coloured substance, called by author *rothic acid*, since it has acid properties and is soluble in ammonia and alcohol. The nucitannic acid is accompanied by ellagic and gallic acids, which interfere, the author says, with the purifying of the nucitannic acid; about the latter, and about rothic acid, the author promises further communications when his researches shall be complete.

Chemisches Centralblatt, No. 26, June 30, 1869.

This number does not contain any original papers, and the whole of its contents have been noticed by us previously from the originals.

Moniteur Scientifique, No. 302, July 15, 1869.

This paper contains a very lengthy essay on—

Designolle's Gunpowder.—M. Jouglet.—The paper is evidently written with the view to bring, if possible, into general use a powder containing picrates, in addition to nitrate of potassa. The paper is too much an essay written for artillery purposes to render it peculiarly suitable for abstraction; but, incidentally, the author speaks of nitroglycerine, and, while on this subject, he positively asserts that nitroglycerine, even when well and carefully made, is spontaneously altered by keeping, becoming acid, and then disengaging gas. This the author asserts is the true clue to the fearful explosions now and then witnessed with this material; and he concludes that if it is to be used at all, it should be made on the spot where it is wanted, and only in such quantities as may be required for blasting during one, or at most two days before.

Among the specifications of French patents, we notice the patent granted to M. Collas, for the—

Application of Phosphate of Lime for Dyeing and Calico Printing.—The author calls attention to the fact that phosphate of lime yields, with various vegetable colours, lakes which are different from those obtained with alumina; that the oxides of copper and cobalt yield, with the freshly-precipitated phosphate of lime, blue-coloured lakes, which greatly surpass, in richness of colour, Thénard's and other blues. The principle of this patent has been long enough known, and, as well remarked by the editor of this paper, it is very questionable whether this matter should be subject to any patent at all.

New Kind of Heating Apparatus for Chemical Laboratories. M. E. Kopp.—This is a rather lengthy description of a complicated set of apparatus intended for heating the laboratory in winter, and, at the same time, supplying at all times a drying stove for filters, &c. The paper describes two kinds of apparatus, in one of which heated air, while in the other steam is applied. It does not, however, appear, from the description, that anything decidedly good is effected by these apparatus, which, from the complicity of construction, cannot but be very expensive; moreover, to be well and readily understood, this paper ought to have been accompanied by a woodcut.

Tinning by the Moist Way.—Dr. Hillier.—It is a well-known fact that, when it is desirable to cover metals, especially brass or copper, with a strongly-adhering coating of tin, this is usually effected by boiling the articles to be thus coated with an aqueous fluid, to which is added cream of tartar, crystallised protochloride of tin, and some lumps of pure metallic tin. The author states that, instead of this mixture, he uses, with very good success, a solution of 1 part of protochloride of tin in 10 parts of water, to which he next adds a solution of 2 parts of caustic soda in 20 parts of water; the mixture becomes turbid, but this does not affect the tinning operation, which is effected by heating the objects to be tinned in this fluid, care being taken, at the same time, to place in the liquid a piece of perforated block-tin plate, and to stir up the fluid during the tinning with a rod of zinc.

Annales des Mines, No. 2, 1869.

This periodical contains the following original papers:—

Some Peculiarities in the Working and Manufacture of Bessemer Steel in Styria and Carinthia.—M. Clérault.—The author of this paper states that, owing to the special advantages due to the excellent iron ores of the countries above named, the manufacture of steel, according to Bessemer's method, is effected with less cost, and yields better results, than is the case elsewhere. The paper is full of practical matters, especially as regards the manufacture of railway iron.

Certain Peculiarities of the Blast Furnaces of the Siegen District.—M. Douville.—The author of this short memoir describes the peculiarities of the blast furnaces established a few years ago in this district of Prussia, wherein, centuries since, iron-works have been in existence, but where only recently the use of coke has been substituted for that of wood. The author's paper is valuable chiefly to ironmasters.

Geological Description and Account of the Mineral Resources of the Canton de Vic Dessos.—M. Musey.—This is the third and concluding portion of a lengthy monograph exposing the mineral resources, and describing the geology, of that portion of the French Département de l'Ariège, which is contiguous to the republic of Andorra, a country wherein mineral wealth abounds. The paper is an excellent monograph on such a subject.

Journal fur Gasbeleuchtung, June, 1869.

This periodical contains an excellent monograph on photometers and their applications under the title of—

Photometrical Studies.—Dr. Rüdorff.—The author's memoir is too lengthy, and enters too deeply into mathematical details, to render it suitable for abstraction, but it is in every respect, an excellent essay on this subject, and duly applied to practical purposes also.

This number contains the first portion of the report of the annual meeting of German gas engineers, held this year at Cobourg. From this report, we learn that, when hydrate of lime is saturated with carbonic acid, it is yet, provided it be moist, capable of taking up sulphuretted hydrogen very energetically, without thereby simultaneously giving off again carbonic acid gas. One of the members of this Association explains, in a few words, that the removal of sulphur from the oxide of iron used in the purifiers may be advantageously effected by means of quicklime; but no particulars of this process are given.

Les Mondes, July 29, 1869.

We notice from this paper:—

The Champonnois Press.—The name of M. Champonnois as an indefatigable industrial genius, is well and very deservedly known to all acquainted with the manufacture of beet-root sugar especially. We learn, from a short notice in the above-named periodical, that the gentleman just named has succeeded in bring out a very greatly improved press for forcing the saccharine juice out of beet-root pulp so as to obtain a larger quantity of saccharine matter from a given weight of pulp, and also to bring the juice to a state of clearness (that is to say, absence of suspended matter) not hitherto obtained. Experiments with this kind of press, which is worked, moreover, with great economy of power, and yet with enormous force, may be witnessed at the works of MM. J. F. Cail and Co., Quai de Grenelle, Paris, where a large number of these presses have been made to order by beet-root sugar manufacturers, to be applied in the ensuing season.

The Academy of Exact Sciences at Madrid has proposed the following prizes to be distributed in 1871:—To discover the best method of making starch in Spain. Description to be given of the divers varieties of vines cultivated in certain parts of Spain, excepting always the provinces of Asturia, Pontevedro, Biscaya, and Castelloo de la Plana. Description to be made of the various rocks met with in one province, at least, of Spain; to indicate their *detritus*, and to point out how this *detritus* contributes to the formation of the agricultural soil in general, and in how far this soil is suitable to the cultivation of trees. The premiums for the approved memoirs are a gold medal and a sum of 1575 francs (£63). The memoirs (written in Spanish, Latin, or French) must be received by the Secretary of the Academy, on or before the 1st of May, 1871.

NOTES AND QUERIES.

Wood-Lice.—I should be very much obliged if any of your correspondents can inform me how to destroy wood-lice in beams, floors, and furniture. It should be something that would not injure or discolour the furniture.—WOOD PRESERVER.

Drying of Animal and Vegetable Substances.—Dr. Müller.—A large glass vessel, a tumbler for instance, is filled for about half its capacity with fused chloride of calcium, and over this a quantity of ether is poured; on the top of the glass vessel another suitable glass or porcelain vessel is placed containing the substance to be dried, and over these vessels, previously placed on a polished glass plate, a bell-jar is placed. The drying takes place in consequence of the fact that the chloride of calcium withdraws water continuously from the ether, and the vapour of the latter, in its turn, withdraws the water from the substances to be dried. It is stated that both animal and vegetable substances dried by this process retain their natural colour, and that animal substances, moreover, retain their elasticity and flexibility.—*Deutsche Ind. Zeitung.*

Dr. Gladstone's Experiments on Light.—Seeing in your report of Dr. Gladstone's Friday evening lecture at the Royal Institution, delivered April 24, 1868, and contained in your impression of June 5, 1868, that he has discovered that, in the case of liquids, $\frac{\mu-1}{d}$ is constant for all temperatures and for all mixtures, with some slight deviations, owing, apparently, to an undiscovered law, you will confer a great favour on me if you will give me the number.—ALEPH.

[Dr. Gladstone informs us that the fact that, in the case of liquids, $\frac{\mu-1}{d}$ is a constant for all temperatures and for mixtures, with some slight deviation, was discovered by Mr. Dale and himself several years ago, and has been verified by some of the German physicists. They (Dr. Gladstone and Mr. Dale) have, however, gone far beyond that now, showing that it is a constant (generally speaking) notwithstanding chemical combination. Dr. Gladstone sent a long paper founded on this to the Royal Society last month.—*Ed.* C. N.]

TO CORRESPONDENTS.

*** Vol. XIX. of THE CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes, are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. XX. commenced on July 2nd, and will be complete in twenty-six numbers.

ERRATUM.—In No. 506, p. 68, line 13 from top, *for* "condemning oleography" *read* "commending oleography."

THE CHEMICAL NEWS.

VOL. XX. No. 508.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

EXETER MEETING, AUGUST 18, 1869.

INAUGURAL ADDRESS OF THE PRESIDENT,

GEORGE GABRIEL STOKES, M.A., Sec. R.S.,
D.C.L., Oxon.; LL.D., Dublin;
Fellow of Pembroke College; and Lucasian Professor of Mathematics in the University of Cambridge.

My LORDS, LADIES, AND GENTLEMEN,—

As this is the first time that the British Association for the Advancement of Science has met in the city of Exeter, and it is probable that many now present have never attended a former meeting, I hope the older members of the Association will bear with me if I say a few words in explanation of the objects for which the Association was instituted. In the first place, then, it aims at fulfilling an office which is quite distinct from that of the various scientific societies which are established in different parts of the country. These, for the most part, have for their leading object to make the voluntary labours of isolated workers in science available to the scientific world generally, by receiving, discussing, and publishing the results which they may have obtained. The British Association, on the other hand, aims at giving *a more systematic direction* to scientific inquiry, and that in various ways.

Objects of the Association.—Scientific Reports.

In a rapidly progressing branch of science it is by no means easy to become acquainted with its actual state. The workers in it are scattered throughout the civilised world, and their results are published in a variety of Transactions and scientific periodicals, mixed with other scientific matter. To make oneself, without assistance, well acquainted with what has been done, it is requisite to have access to an extensive library, to be able to read with facility several modern languages, and to have leisure to hunt through the tables of contents, or at least the indices, of a number of serial works. Without such knowledge, there is always the risk that a scientific man may spend his strength in doing over again what has been done already; whereas, with better direction, the same expenditure of time and labour might have resulted in some substantial addition to our knowledge. With a view to meet this difficulty, the British Association has requested individuals who were more specially conversant with particular departments of science, to draw up reports on the present state of our knowledge in, or on the recent progress of, special branches; and the influence of the Association as a public body has been found sufficient to induce a number of scientific men to undertake the great labour of preparing such reports.

By thus ascertaining thoroughly what we already had, what we still wanted was made more clear; and, indeed, it was one special object of the reports I have mentioned to point out what were the more prominent desiderata in the various subjects to which they related. The Association was thus the better enabled to fulfil another of its functions, that of organising means for the prosecution of researches which require co-operation. When the want is within the compass of what can be accomplished by individuals, the demand may be left to create the supply; but it often happens that a research can hardly be carried out without co-operation. It may, for instance, require a combination of the most profound theoretical knowledge with the greatest experimental skill, or an extensive knowledge of very dissimilar branches of science; or, again, the work to be done, though all of one kind, may be of such an extent as to be beyond the power of any one man. In such cases, the limited power of the individual can only be supplemented by the principle of co-operation; and, accordingly, it becomes an important part of the business of the Association to organise committees for the prosecution of special researches. The researches thus undertaken, at the request of the Association, are published at length, along with the reports on the progress of science, in the first part of the annual volume.

Money Grants.

In close connection with the last, must be mentioned another mode in which the Association contributes to the progress of science. Many researches require not only time and thought, but pecuniary outlay; and it would seem hard that scientific men who give their time and labour gratuitously to carrying out such researches should be further obliged to incur an expenditure which they often can ill afford. The Association accordingly makes grants of money to individuals or committees for defraying the expenses of such researches. It appears, from the report which has just been published, that, reckoning up to the year 1867 inclusive, the sum of £29,312 4s. 1d. has been voted by the Association for various scientific objects. Deducting from this the sum of £23 16s., for the balances of grants not wholly expended, which were returned to the Association, we may say that £29,288 8s. 1d. has been expended in the manner indicated. When we remember that these grants were mostly of small amount, and do not include personal expenses, and that very many of the researches undertaken at the request of the Association do not involve money grants at all, we may form some idea of the amount of scientific activity which has been evoked under the auspices of the Association.

Recent Progress of Science.

In the address with which the business of the meeting is opened, it is usual for your President to give some account of the most recent progress of science. The task is by no means an easy one. Few, indeed, are familiar with science in all its branches; and even to one who was, the selection of topics, and the mode of treating them, would still present difficulties. I shall not attempt to give an account of the recent progress of science in general, but shall select, from those branches with which I am more familiar some examples of recent progress, which may, I hope, prove to be of pretty general interest. And even in this, I feel that I shall have to crave your indulgence; for it is hard to be intelligible to some without being wearisome to others.

Astronomy.

Among the various branches of physical science, astronomy occupies, in many respects, a foremost rank. The movements of the heavenly bodies must have occupied the attention and excited the interest of mankind from the earliest ages, and accordingly the first rudiments of the science are lost in the depths of antiquity. The grandeur of the subjects of contemplation which it presents to us have won for it especial favour, and its importance in relation to navigation has caused it to be supported by national resources. Newton's great discovery of universal gravitation raised it from the rank of a science of observation to that of one admitting of the most exact mathematical deduction; and the investigation of the consequences of this law, and the explanation thereby of the lunar and planetary disturbances, have afforded a field for the exercise of the highest mathematical powers on the

part of Newton and his successors. Gradually the apparent anomalies, as they might have been deemed, in the motions of the heavenly bodies, were shown to be necessary consequences of the one fundamental law; and at last, as the result of calculations of enormous labour, tables were constructed enabling the places of those bodies at any given time to be determined years beforehand with astonishing precision. A still more striking step was taken. When it had been shown, by careful calculation, that the apparent motion of the remotest of the planets then known to belong to our system could not be wholly explained on the theory of gravitation, by taking account of the disturbing powers of the other known planets, Adams, in our own country, and Le Verrier, in France, boldly reversed the problem, and, instead of determining the disturbing effect of a known planet, set themselves to inquire what must be the mass and orbit of an unknown planet which shall be capable of producing, by its disturbing force, the unexplained deviations in the position of Uranus from its calculated place. The result of this inquiry is too well known to require notice.

After these brilliant achievements, some may, perhaps, have been tempted to imagine that the field of astronomical research must have been well-nigh exhausted. Small perturbations, hitherto overlooked, might be determined, and astronomical tables thereby rendered still more exact. New asteroids might be discovered by the telescope. More accurate values of the constants with which we have to deal might be obtained. But no essential novelty of principle was to be looked for in the department of astronomy; for such we must go to younger and less mature branches of science.

Researches which have been carried on within the last few years, even the progress which has been made within the last twelve months, shows how short-sighted such an anticipation would have been; what an unexpected flood of light may sometimes be thrown over one science by its union with another; how conducive, accordingly, to the advancement of science may be an association like the present, in which not only are the workers at special sciences brought together in the Sectional Meetings, but in the General Meetings of the Association, and in the social intercourse, which, though of an informal character, is no unimportant part of our proceedings, the cultivators of different branches of science are brought together, and have an opportunity of enlarging their minds by contact with the minds of others, who have been used to trains of thought of a very different character from their own.

The Velocity of Light.

The science of astronomy is indebted to that of optics for the principles which regulate the construction of those optical instruments which are so essential to the astronomer. It repaid its debt by furnishing to optics a result which it is important we should keep in view in considering the nature of light. It is to astronomy that we are indebted for the first proof we obtained of the finite velocity of light, and for the first numerical determination of that enormous velocity. Astronomy, again, led, forty-four years later, to a second determination of that velocity in the remarkable phenomenon of aberration discovered by Bradley, a phenomenon presenting special points of interest in relation to the nature of light, and which has given rise to some discussion, extending even to the present day, so that the Astronomer Royal has not deemed it unworthy of investigation, laborious as he foresees the trial is likely to prove, to determine the constant of aberration by means of a telescope having its tube filled with water.

If, in respect of these phenomena, optics received much aid from astronomy, the latter science has been indebted to the former for information which could not otherwise have been obtained. The motions and the masses of the heavenly bodies are revealed to us more or less fully by astronomical observations; but we could not thus become acquainted with the chemical nature of these distant objects. Yet, by the application of the spectroscope to the scrutiny of the heavenly bodies, evidence has been obtained of the existence therein of various elements known to us by the chemical examination of the materials of which our own earth is composed; and not only so, but light is thrown on the state in which matter is there existing, which, in the case of nebulæ especially, led to the formation of new ideas respecting their constitution, and the rectification of astronomical speculations previously entertained. I shall not, however, dwell further on this part of the subject, which is now of some years' standing, and has been mentioned by more than one of your former presidents, but will pass on to newer researches in the same direction.

Proper Motion of the Fixed Stars.

We are accustomed to apply to the stars the epithet *fixed*. Night after night they are seen to have the same relative arrangement; and when their places are determined by careful measurement, and certain small corrections due to known causes are applied to the immediate results of observation, they are found to have the same relative distances. But when instead of days the observations extend over months or years, it is found that the fixity is not quite absolute. Defining as fixity invariability of position as estimated with reference to the stars as a whole, and comparing the position of any individual star with those of the stars in its neighbourhood, we find that some of the stars exhibit "proper motions," show, that is, a progressive change of angular position as seen from the earth, or rather as they would be seen from the sun, which we may take for the mean annual place of the earth. This indicates linear motion in a direction transverse to the line joining the sun with the star. But since our sun is merely a star, a line drawn from the star exhibiting proper motion to our sun is, as regards the former, merely a line drawn to a star taken at random, and therefore there is no reason why the star's motion should be, except accidentally, in a direction perpendicular to the line joining the star with our sun. We must conclude that the stars, including our own sun, or some of them at least, are moving in various directions in space, and that it is merely the transversal component of the whole motion, or rather of the motion relatively to our sun, that is revealed to us by a change in the star's apparent place.

How then shall we determine whether any particular star is approaching to or receding from our sun? It is clear that astronomy alone is powerless to aid us here, since such a motion would be unaccompanied by change of angular position. Here the science of optics comes to our aid in a remarkable manner.

The pitch of a musical note depends, as we know, on the number of vibrations which reach the ear in a given time, such as a second. Suppose, now, that a body, such as a bell, which is vibrating a given number of times per second, is at the same time moving from the observer, the air being calm. Since the successive pulses of sound travel all with the velocity of sound, but diverge from different centres, namely, the successive points in the bell's path at which the bell was when those pulses were first excited, it is evident that the sound-waves will be somewhat more spread out on the side from which the bell is moving, and more crowded together on the side towards which it is moving, than if the bell had been at rest. Consequently the number of vibrations per second which reach the ear of an observer situated in the former of these directions will be somewhat smaller, and the number which reach an observer situated in the opposite direction somewhat greater, than if the bell had been at rest. Hence to the former the pitch will be somewhat lower, and to the latter somewhat higher, than the natural pitch of the bell. And the same thing will happen if the observer be in motion instead of the bell, or if both be in motion; in fact, the effect depends only on the *relative* motion of the observer and the bell in the direction of a line joining the two—in other words, on the velocity of re-

cession or approach of the observer and the bell. The effect may be perceived in standing by a railway when a train in which the steam-whistle is sounding passes by at full speed, or better still, if the observer be seated in a train which is simultaneously moving in the opposite direction.

The present state of optical science is such as to furnish us with evidence of a force which is perfectly overwhelming, that light consists of a tremor or vibratory movement propagated in an elastic medium filling the planetary and stellar spaces, a medium which thus fulfils for light an office similar to that of air for sound. In this theory, to difference of periodic time corresponds difference of refrangibility. Suppose that we were in possession of a source of light capable, like the bell in the analogous case of sound, of exciting in the æther supposed at rest vibrations of a definite period, corresponding, therefore, to light of a definite refrangibility. Then, just as in the case of sound, if the source of light and the observer were receding from or approaching to each other with a velocity which was not insensibly small compared with the velocity of light, an appreciable lowering or elevation of refrangibility would be produced, which would be capable of detection by means of a spectroscope of high dispersive power.

Alteration of the Refrangibility of a Ray of Light.

The velocity of light is so enormous, about 185,000 miles per second, that it can readily be imagined that any motion which we can experimentally produce in a source of light is as rest in comparison. But the earth in its orbit round the sun moves at the rate of about 18 miles per second; and in the motions of stars approaching to or receding from our sun we might expect to meet with velocities comparable with this. The orbital velocity of the earth is, it is true, only about the one ten-thousandth part of the velocity of light. Still the effect of such a velocity on the refrangibility of light, which admits of being easily calculated, proves not to be so insensibly small as to elude all chance of detection, provided only the observations are conducted with extreme delicacy.

But how shall we find in such distant objects as the stars an analogue of the bell which we have assumed in the illustration drawn from sound? What evidence can we ever obtain, even if an examination of their light should present us with rays of definite refrangibility, of the existence in those remote bodies of ponderable matter vibrating in known periods not identical with those corresponding to the refrangibilities of the definite rays which we observe? The answer to this question will involve a reference, which I will endeavour to make as brief as I can, to the splendid researches of Professor Kirchhoff. The exact coincidence of certain dark lines in the solar spectrum with bright lines in certain artificial sources of light had previously been in one or two instances observed; but it is to Kirchhoff we owe the inference from an extension of Prevost's theory of exchanges, that a glowing medium which emits bright light of any particular refrangibility *necessarily* (at that temperature at least) acts as an absorbing medium, extinguishing light of the same refrangibility. In saying this it is but just to mention that, in relation to radiant heat (from whence the transition to light is easy), Kirchhoff was preceded, though unconsciously, by our own countryman, Mr. Balfour Stewart. The inference which Kirchhoff drew from Prevost's theory thus extended led him to make a careful comparison of the places of the dark lines of the solar spectrum with those of bright lines produced by the incandescent gas or vapour of known elements; and the coincidences were in many cases so remarkable as to establish almost to a certainty the existence of several of the known elements in the solar atmosphere, producing by their absorbing action the dark lines coinciding with the bright lines observed. Among other elements may be mentioned in particular hydrogen, the spectrum of which, when traversed by an electric discharge, shows a bright line or band exactly coinciding with the dark line C, and another with the line F.

Mr. Huggins's Researches on Sirius—Determination of Radial Proper Motion.

Now Mr. Huggins found that several of the stars show in their spectra dark lines coinciding in position with C and F; and what strengthens the belief that this coincidence, or apparent coincidence, is not merely fortuitous, but is due to a common cause, is that the two lines are found associated together, both present or both absent; and Kirchhoff's theory suggests that the common cause is the existence of hydrogen in the atmospheres of the sun and certain stars, and its exercise of an absorbing action on the light emitted from beneath.

Now, by careful and repeated observations with a telescope furnished with a spectroscope of high dispersive power, Mr. Huggins found that the F line, the one selected for observation, in the spectrum of Sirius did not exactly coincide with the corresponding bright line of a hydrogen spark, which latter agrees in position with the solar F, but was a *little* less refrangible, while preserving the same general appearance. What conclusion, then, are we to draw from the result? Surely it would be most unreasonable to attribute the dark lines in the spectra of the sun and of Sirius to distinct causes, and to regard their almost exact coincidence as purely fortuitous, when we have in proper motion a *vera causa* to account for a minute difference. And if, as Kirchhoff's labours render almost certain, the dark solar line depends on the existence of hydrogen in the atmosphere of our sun, we are led to infer that that element, with which the chemist working in his laboratory is so familiar, exists and is subject to the same physical laws in that distant star, so distant, that, judging by the most probable value of its annual parallax, light which would go seven times round our earth in one second would take fourteen years to travel from the star. What a grand conception of the unity of plan pervading the universe do such conclusions present to our minds!

Assuming, then, that the small difference of refrangibility observed between the solar F and that of Sirius is due to proper motion, Mr. Huggins concludes from his measures of the minute difference of position that at the time of the observation, Sirius was receding from the earth at the rate of 41·4 miles per second. A part of this was due to the motion of the earth in its orbit; and on deducting the orbital velocity of the earth, resolved in the direction of a line drawn from the star, there remained 29·4 miles per second as the velocity with which Sirius and our sun are mutually receding from each other. Considering the minuteness of the quantity on which the result depends, it is satisfactory to find that Mr. Huggins's results as to the motion of Sirius have been confirmed by the observations of Father Secchi made at Rome with a different instrument.

The determination of radial proper motion in this way is still in its infancy. It is worthy of note that, unlike the detection of transversal proper motion by change of angular position, it is equally applicable to stars at all distances, provided they are bright enough to render the observations possible. It is conceivable that the results of these observations may one day lead to a determination of the motion of the solar system in space, which is more trustworthy than that which has been deduced from changes of position, as being founded on a broader induction, and not confined to conclusions derived from the star in our neighbourhood. Should even the solar system and the nearer stars be drifting along, as Sir John Herschel suggests, with an approximately common motion, like motes in a sunbeam, it is conceivable that the circumstance might thus be capable of detection. To what wide speculations are we led as to the possible progress of our knowledge when we put together what has been accomplished in different branches of science

Spectrum Observations of the Solar Eclipse.

I turn now to another recent application of spectral analysis. The phenomenon of a total solar eclipse is described by those who have seen it as one of the most imposing that can be witnessed. The rarity of its occurrence and the shortness of its duration afford, however, opportunity for only a hasty study of the phenomena which may then present themselves. Among these, one of the most remarkable, seen indeed before, but first brought prominently into notice by the observers who watched the eclipse of July 7, 1842, consists in a series of mountain-like or cloud-like luminous objects seen outside the dark disk of the moon. These have been seen in subsequent total eclipses, and more specially studied, by means of photography, by Mr. Warren De La Rue in the eclipse of June 18, 1860. The result of the various observations, and especially the study, which could be made at leisure, of the photographs obtained by Mr. De La Rue, proved conclusively that these appendages belong to the sun, not to the moon. The photographs proved further their light to be remarkable for actinic power. Since that time the method of spectral analysis has been elaborated; and it seemed likely that additional information bearing on the nature of these objects might be obtained by the application of the spectroscope. Accordingly various expeditions were equipped for the purpose of observing the total solar eclipse which was to happen on August 17, 1868. In our own country an equatorially mounted telescope, provided with a spectroscope, was procured for the purpose by the Royal Society, which was entrusted to Lieut. (now Captain) Herschel, who was going out to India, one of the countries crossed by the line of the central shadow. Another expedition was organised by the Royal Astronomical Society, under the auspices of Major Tennant, who was foremost in pressing on the attention of scientific men the importance of availing themselves of the opportunity.

Shortly before the conclusion of the meeting of the Association at Norwich last year, the first results of the observations were made known to the meeting through the agency of the electric telegraph. In a telegram sent by M. Janssen to the President of the Royal Society, it was announced that the spectrum of the prominences was very remarkable, showing bright lines, while that of the corona showed none. Brief as the message necessarily was, one point was settled. The prominences could not be clouds in the strict sense of the term, shining either by virtue of their own heat, or by light reflected from below. They must consist of incandescent matter in the *gaseous* form. It appeared, from the more detailed accounts received by post from the various observers, and put together at leisure, that, except in the immediate neighbourhood of the sun, the light of the prominences consisted mainly of three bright lines, of which two coincided with C and F, and the intermediate one nearly, but, as subsequent researches showed, not exactly with D. The bright lines coinciding with C and F indicate the presence of glowing hydrogen. Several of the other lines were identified with those which would be produced by the incandescent vapour of certain other elements.

This is precious information to have gathered during the brief interval of the total phase, and required, on the part of the observers, self-denial in withdrawing the eye from the imposing spectacle of the surrounding scenery, and coolness in proceeding steadily with some definite part of the inquiry, when so many questions crowded for solution, and the fruits of months of preparation were to be reaped in three or four minutes or lost altogether, especially when, as too often happened, the observations were provokingly interrupted by flying clouds.

But, valuable as these observations were, it is obvious that we should have had long to wait before we could have become acquainted with the usual behaviour of these objects, and their possible relation to changes which may be going on at the surface of the sun, if we had been dependent on the rare and brief phenomenon of a total solar eclipse for gathering information respecting them. But, how, the question might be asked, shall we ever be able so to subdue the overpowering glare of our great luminary, and the dazzling illumination which it produces in our atmosphere when we look nearly in its direction, as to perceive objects which are comparatively so faint? Here, again, the science of optics comes in aid of astronomy.

Spectral Examination of the Eclipse Prominences.

When a line of light—such as a narrow slit held in front of a luminous object—is viewed through a prism, the light is ordinarily spread out into a coloured band, the length of which may be increased at pleasure by substituting two or more prisms for the single prism. As the total quantity of light is not thereby increased, it is obvious that the intensity of the light of the coloured band will go on decreasing as the length increases. Such is the case with ordinary sources of light—like the flame of a candle, or the sky, which give a continuous spectrum, or one generally continuous, though interrupted by dark bands. But, if the light from the source be homogeneous, consisting, that is, of light of one degree of refrangibility only, the image of the slit will be merely deviated by the prisms, not widened out into a band, and not consequently reduced in intensity by the dispersion. And, if the source of light emit light of both kinds, it will be easily understood that the images of the slit corresponding to light of any definite refrangibilities which the mixture may contain will stand out, by their superior intensity, on the weaker ground of the continuous spectrum.

Preparations for observations of the kind had long been in progress in the hands of our countryman Mr. Lockyer. His first attempts were unsuccessful; but, undismayed by failure, he ordered the construction of a new spectroscope of superior power, in which he was aided by a grant from the sum placed annually by Parliament at the disposal of the Royal Society for scientific purposes. The execution of this instrument was delayed by what proved to be the last illness of the eminent optician to whom it was entrusted (the late Mr. Cooke); but, when at last the instrument was placed in his hands, Mr. Lockyer was not long in discovering the object of his two years' search. On the 20th of October last year, in examining the space immediately surrounding the edge of the solar disk, he obtained evidence, by the occurrence of a bright line in the spectrum, that his slit was on the image of one of those prominences the nature of which had so long been an enigma. It further appeared, from an observation made on November 5th (as, indeed, might be expected from the photographs of Mr. De La Rue, and the descriptions of those who had observed total solar eclipses), that the prominences were merely elevated portions of an extensive luminous stratum of the same general character, which, now that the necessity of the interposition of the moon was dispensed with, could be traced completely round the sun. Notices of this discovery were received from the author by the Royal Society on October 21st and November 3rd, and the former was almost immediately published in No. 105 of the "Proceedings." These were shortly afterwards followed by a fuller paper on the same subject.

Meanwhile, the same thing had been independently observed in another part of the world. After having observed the remarkable spectrum of the prominences during the total eclipse, it occurred to M. Janssen that the same method might allow the prominences to be detected at any time; and, on trial, he succeeded in detecting them the very day after the eclipse. The results of his observations were sent by post, and were received shortly after the account of Mr. Lockyer's discovery had been communicated by Mr. De La Rue to the French Academy.

In the way hitherto described, a prominence is not seen as a whole, but the observer knows when its image is intercepted by the slit; and, by varying a little the position of the slit, a series of sections of the prominence

are obtained, by putting which together the form of the prominence is deduced. Shortly after Mr. Lockyer's communication of his discovery, Mr. Huggins, who had been independently engaged in the attempt to render the prominences visible by the aid of the spectroscope, succeeded in seeing a prominence as a whole by somewhat widening the slit, and using a red glass to diminish the glare of the light admitted by the slit, the prominence being seen by means of the c line in the red. Mr. Lockyer had a design for seeing the prominences as a whole by giving the slit a rapid motion of small extent; but this proved to be superfluous, and they are now habitually seen with their actual forms. Nor is our power of observing them restricted to those which are so situated that they are seen by projection outside the sun's limb; such is the power of the spectroscopic method of observation that it has enabled Mr. Lockyer and others to observe them right on the disk of the sun—an important step for connecting them with other solar phenomena.

One of the most striking results of the habitual study of these prominences is the evidence they afford of the stupendous changes which are going on in the central body of our system. Prominences, the heights of which are to be measured by thousands and tens of thousands of miles, appear and disappear in the course of some minutes. And a study of certain minute changes of position in the bright line F, which receive a simple and natural explanation by referring them to proper motion in the glowing gas by which that line is produced, and which we see no other way of accounting for, have led Mr. Lockyer to conclude that the gas in question is sometimes travelling with velocities comparable with that of the earth in its orbit. Moreover, these exhibitions of intense action are frequently found to be intimately connected with the spots, and can hardly fail to throw light on the disputed question of their formation. Nor are chemical composition and proper motion the only physical conditions of the gas which are accessible to spectral analysis. By comparing the breadth of the bright bands (for, though narrow, they are not mere lines) seen in the prominences with those observed in the spectrum of hydrogen rendered incandescent under different physical conditions, Dr. Frankland and Mr. Lockyer have deduced conclusions respecting the pressure to which the gas is subject in the neighbourhood of the sun. I am happy to say that Mr. Lockyer has consented to deliver a discourse during our meeting, in which the whole subject will doubtless be fully explained.

The Great Southern Telescope.

I have dwelt, perhaps, too long on this topic, and I cannot help fearing that I may have been tedious to the many scientific men to whom the subject is already perfectly familiar; yet the contemplations which it opens out to us are so exalted, and the proof which it affords of what can be accomplished by the union of different branches of science is so striking, that I hope I may be pardoned for occupying your time. I cannot, however, leave the subject of astronomy without congratulating the Association on the accomplishment of an object which originated with it, and in the promotion of which it formerly took an active part. It was at the meeting of the Association at Birmingham in 1849, under the presidency of the Rev. Dr. Robinson, that a resolution was passed for making an application to Her Majesty's Government to establish a reflector of not less than 3 feet aperture at the Cape of Good Hope, and to make such additions to the staff of that observatory as might be necessary for its effectual working. This resolution met with the hearty concurrence of the President of the Council of the Royal Society, who suggested that the precise locality in the Southern Hemisphere where the telescope should be erected had best be left an open question. This modification having been adopted by your Council, the application was presented to Earl Russell, then First Lord of the Treasury, by representatives of both bodies early in 1850. A reply was received from Government to the effect that, though they agreed with the Association as to the interest which attached itself to the inquiry, yet there was so much difficulty attending the arrangements that they were not prepared to take any steps without much further inquiry. This reply was considered so far favourable as not to forbid the hope of success if the application were renewed on a suitable opportunity. The subject was again brought before the Association, by Colonel (now General Sir Edward) Sabine, in his opening address as President at the Belfast meeting in 1852. The result was that the matter was again brought before Government by a Committee of the British Association acting in conjunction with a Committee of the Royal Society, by means of an application made to the Earl of Aberdeen. By this time the country was engaged in the Russian war, in consequence of which it was replied, no funds could then be spared; but a promise was given that, when the crisis then impending was past, the matter should be taken up—a promise which the retirement from office and subsequent death of Lord Aberdeen rendered of no avail.

But, though failing in its immediate object, the action of the British Association in this matter has not remained fruitless. A few years later, the subject was warmly taken up at Melbourne, and, after preliminary correspondence between the Board of Visitors of the Melbourne Observatory and the President and Council of the Royal Society, and the appointment by the latter body of a committee to consider and report on the subject, in April, 1864, a proposition was made to the Colonial Legislature for a grant of £5000 for the construction of a telescope, and was acceded to. Not to weary you with details, I will merely say that the telescope has been constructed by Mr. Grubb, of Dublin, and is now erected at Melbourne, and in the hands of Mr. Le Sueur, who has been appointed to use it. It is a reflector of 4 feet aperture, of the Cassegrain construction, equatorially mounted, and provided with a clock-movement. Before its shipment, it was inspected in Dublin by the committee appointed by the Royal Society to consider the best mode of carrying out the object for which the vote was made by the Melbourne Legislature; and the committee speak in the highest terms of its contrivance and execution. We may expect before long to get a first instalment of the results obtained by a scrutiny of the southern heavens with an instrument far more powerful than any that has hitherto been applied to them—results which will, at the same time, add to our existing knowledge, and redound to the honour of the colony by whose liberality this long-cherished object has at last been effected.

(To be continued.)

Section B.

ADDRESS
TO THE
CHEMICAL SECTION.

AUGUST 19, 1869.

By Dr. DEBUS, F.R.S., President.

I BELIEVE it has been the custom with many of my predecessors in this office to place before the members of the British Association a Report of the progress of Chemistry during the year preceding their election. In attempting to follow their example, I soon found that it would be impossible for me, without making too great a demand upon your time, to give even a bare outline of the more important chemical work done during the year. A science, the report of whose yearly advances fills about 1000 large octavo pages, cannot, by any powers of mine, have its progress chronicled in an address of half an hour's duration. The best course open to me under such ci-

is to direct your attention to the ideas which at present guide chemists in their researches, to place in a clear light the objects they are striving to attain, and to indicate the direction of scientific thought of our time. To do this is by no means an easy task; for the more manifold and diversified the objects of a science become—the more numerous and extensive its relations with other branches of knowledge, the more difficult it becomes to draw a picture of its actual condition.

It is always an excellent recommendation to a theory or hypothesis when, amongst the cultivators of the science to which it pertains, very little difference of opinion exists as regards its admissibility and scientific value. This is, in a high degree, the case with regard to the atomic theory. The vast majority of chemists, I believe, accept this theory as the most suitable exponent of the fundamental truths of their science; and certainly, if the quality of the tree may be judged by its fruit, there is no other view which furnishes a clearer image to our minds of the chemical constitution of bodies, and, at the same time, conducts to the discovery of so many important facts and relations. By Dalton's profound hypothesis, all bodies are supposed to be composed of atoms of infinitely small dimensions. But these atoms are supposed not to be single; two or more of them are held together by certain forces, and thus constitute what is called a molecule. One atom of carbon, one atom of calcium, and three atoms of oxygen, joined together by the force called chemical affinity, constitute a molecule of carbonate of lime. Vast numbers of such molecules, bound to each other by the force of cohesion, form a visible piece of chalk. If a chemist wishes to examine a body, his first endeavour is to ascertain of what sort of atoms the body is formed. This is a mere matter of experiment. He next determines how many of such atoms are contained in each molecule of the body, and, finally, he ascertains how these atoms are arranged, or, more correctly, combined within the molecule; for it is quite clear that a substance like saltpetre, which contains one atom of nitrogen, one of potassium, and three of oxygen, may have these atoms arranged in very different manners, and still have the same composition. We might assume the potassium and nitrogen in more intimate union, nearer to each other than they are to oxygen, or we might consider nitrogen and oxygen more closely packed together, and, so to speak, attached as a whole to the potassium; in both cases, saltpetre would have in each molecule the same number of atoms, and the weight of the molecule would be the same. The three determinations just mentioned are of fundamental importance to the chemist; not that such inquiries are the only ones which interest him, for we shall, in the sequel, notice others of almost equal importance.

Nor must it be supposed that questions of this nature are of quite a modern date; for Leucippus, 500 B.C., appears to have sought to explain the nature of things, by the assumption that they are formed by the union of small particles, which latter received the name of atoms from Epicurus. It is true the notion of atoms, as conceived by the Grecian philosophers, is not quite the same as ours, but their speculations contain our notions pretty much in the same way as the acorn contains the oak-tree.

The determination of the quality of the atoms in a molecule, or the analysis of the latter, has not undergone many changes during the last few years; and the same may be said about the finding of the relative weight of a molecule, or the determination of the number of atoms which are contained in it. With regard to the latter point, however, it may be mentioned that Avogadro's hypothesis, according to which equal volumes of gaseous substances, measured at the same temperature and pressure, contain the same number of molecules, guides us chiefly in assigning to each molecule its relative weight and its number of atoms; this hypothesis has won more and more the confidence of chemists, and it is now admitted to hold good in nearly all well-examined cases.

Our views relative to the combinations of atoms in molecules, and our methods of ascertaining this arrangement, have, however, undergone great alterations, and received great additions, during the last ten or fifteen years. To a consideration of these changes I will now, for a short time, invite your attention. Since our modern views, however, originated, in a great measure, from the study of organic bodies, and since the majority of chemists now devote their time and labour thereto, I shall confine my remarks principally to the organic branch of the subject.

Eighteen years ago, Prof. Williamson read before the members of this Association a remarkable paper, which contained the germ of our modern chemical views, and was the cause of many discoveries. He proposed to regard three large classes of bodies, acids, bases, and salts from the same point of view, and to compare their chemical properties with those of one single elected substance. For this term of comparison he chose water. Now water is composed of three atoms—two of hydrogen and one of oxygen. Williamson showed that all oxygen acids—all oxygen bases, and the salts resulting from a combination of the two—can, like water, be considered to be composed of three parts, or radicals, two of the radicals playing the part of the hydrogen atoms in water, and the third that of the atom of oxygen, thus:—

$\left.\begin{matrix}H\\H\end{matrix}\right\}O$	$\left.\begin{matrix}K\\H\end{matrix}\right\}O$	$\left.\begin{matrix}NO\\H\end{matrix}\right\}O$	$\left.\begin{matrix}NO\\K\end{matrix}\right\}O$
Water.	Potassic hydrate.	Hydric nitrite.	Potassic nitrite.

Potassic hydrate is water which has one of its atoms of hydrogen replaced by an atom of potassium; hydric nitrite is water which has one atom of hydrogen replaced by nitric oxide; and potassic nitrite is water with one of its hydrogen atoms replaced by nitric oxide, and the other by potassium. This speculation, as every chemist knows, is well supported by experiments; it embraces three large classes of bodies which, till then, had been considered as distinct. M. Gerhardt, in 1853, extended Williamson's views, by distinguishing two other types of molecular structure, represented, respectively, by hydrogen and ammonia, and succeeded, by help of the radical theory, in arranging the majority of the then known substances under one or the other of the three types already mentioned.

Like every theory which is in harmony with experience, the above considerations led to results of unexpected importance; for it soon became apparent that the radicals which thus replace hydrogen in water are not all of the same chemical value. If we place together the formulæ of hydric nitrite and carbonic acid—

$\left.\begin{matrix}NO\\H\end{matrix}\right\}O$	$CO\}O$
Hydric nitrite.	Carbonic acid.

we perceive, at once, that the atomic group NO has replaced one atom of hydrogen in one molecule of water, and carbonic oxide, CO, two atoms of hydrogen in one molecule of water. Nitric oxide (NO) is, therefore, said to be equivalent to one atom of hydrogen, and carbonic oxide (CO) equivalent to two atoms of hydrogen. The radical of phosphoric acid [PO] is found to be equivalent to three atoms of hydrogen. Professor Odling was one of the first to observe this difference in the equivalence of atoms, and groups of atoms, or compound radicals, as they are termed, a difference which he marks, as shown in the following examples:—

Radicals.

Equivalent to one atom of hydrogen.		Equivalent to two atoms of hydrogen.	
Nitric oxide	$(NO)'$	Carbonic oxide	$[CO]''$
Methyl	$(CH_3)'$	Methylene	$[CH_2]''$
Ethyl	$(C_2H_5)'$	Ethylene	$[C_2H_4]''$

The notion of equivalence enabled Professor Kekule to form most interesting speculations on the constitution of organic bodies, and to explain the relation between composition and equivalence of such radicals as methyl, CH_3,

ethyl, C_2H_5, methylene, CH_2, ethylene, C_2H_4, and acetylene, C_2H_2.

If from one molecule of marsh gas, CH_4, one atom of hydrogen is abstracted, the residue, CH_3, called methyl, can combine with an atom of hydrogen again, and produce the original marsh-gas molecule. But methyl, instead of combining with an atom of hydrogen, can unite with an atom of chlorine, or an atom of bromine, that is to say, the place of the atom of hydrogen can be taken by an atom of chlorine or bromine. Methyl being thus equivalent to an atom of hydrogen, is said to be monovalent. If from a molecule of marsh-gas two atoms of hydrogen are removed, the residue, CH_2, called methylene, can again unite with two atoms of hydrogen, or, instead of hydrogen, two atoms of chlorine or bromine, and from the compounds CH_4, $CHCl_2$, CH_2, Br_2 respectively. Methylene, therefore, being equivalent to two atoms of hydrogen, is termed divalent. The radical CH, left after the abstraction of three atoms of hydrogen from marsh-gas, is able to re-produce with three atoms of hydrogen one molecule of marsh-gas, or to combine with three atoms of chlorine, and form chloroform, $CHCl_3$. The residue, CH, is thus trivalent or equivalent to three atoms of hydrogen. In the same manner carbon is found to be tetravalent or equivalent to four atoms of hydrogen. But carbon, formen [CH], methylene, CH_2, methyl, CH_3, not only combine with hydrogen, chlorine, or other elements according to their equivalence, but also amongst themselves, and thus produce the so-called hydrocarbons, native as well as artificial. Methyl combines with methyl and produces dimethyl, or better known as ethylic hydride, $CH_3+CH_3=C_2H_6$; methylene combines with methylene, and forms ethylene, $CH_2+CH_2=C_2H_4$. Methylene is divalent, and methyl monavalent; therefore methylene combines with two equivalents of methyl and forms propylic hydride, C_3H_8, $CH_2+2CH_3=C_3H_8$. Six equivalents of formen are supposed to be contained in benzol $[C_6H_6]$, $6CH=C_6H_6$.

What has been said of marsh-gas also applies to ammonia and water. Ammonia, NH_3, minus one atom of hydrogen, forms the monovalent radical, NH_2, minus two atoms of hydrogen, the divalent radical, NH, and nitrogen itself trivalent, that is to say, it can replace three atoms of hydrogen in compounds, or can combine with three atoms of hydrogen. Water minus one atom of hydrogen produces the monovalent radical hydroxyl, HO, and water without both atoms of hydrogen gives us divalent oxygen. These radicals, NH_2, NH, N, HO, and O, can combine with each other, and with methyl, methylene, formen, and carbon respectively in different proportions. Thus methyl, methylene, and hydroxyl are contained in common alcohol. The union of methyl, carbon, oxygen, and hydroxyl gives acetic acid, $C_2H_4O_2$,

$$CH_3+C+O+HO=C_2H_4O_2.$$

Glycocoll is considered as a combination of methylene amidogen $[NH_2]$, carbon, oxygen, and hydroxyl:—

$$CH_2+NH_2+C+O+HO=C_2H_5NO_2=\text{glycocoll.}$$

The radicals C, CH, CH_2, CH_3, HO, O, N, NH, NH_2, and CO are considered to form the proximate constituents of the most important organic compounds. It often happens that, from the union of the same radicals, two or more bodies of the same composition, but differing from one another in properties, result. Glycocoll, as well as glycolamide, contain the radicals methylene, hydroxyl, carbonic oxide, and amidogen, NH_2. In such cases the nature of the compound depends on the arrangement of the radicals, as may be seen by the following formulæ:—

$$CH_2.NH_2.CO.HO = C_2H_5NO_2 = \text{glycocoll,}$$
$$CH_2.HO.CO.NH_2 = C_2H_5NO_2 = \text{glycolamide.}$$

Now, the great problem with whose solutions scientific chemists are occupied is *to determine, first, what sort of radicals of the above nature are contained in a given organic body, and, second, how these radicals are grouped amongst each other.*

There are several ways of solving this problem. The molecule may be built up by placing the radicals which are supposed to exist in it under suitable conditions in contact. Two molecules of iodopropionic acid placed together with metallic silver will lose their iodine, and the residues of the two molecules remain united. A new acid, called adipic acid, is thus formed.

$$\left.\begin{matrix}\text{Iodopropionic}\\ \text{acid}\end{matrix}\right\}\begin{matrix}CO.HO\\ CH_2\\ CH_2I\end{matrix} + Ag = 2AgI + \left\{\begin{matrix}COHO\\ CH_2\\ CH_2\\ CH_2\\ CH_2\\ COHO\end{matrix}\right. = \text{adipic acid.}$$
$$\left.\begin{matrix}\text{Iodopropionic}\\ \text{acid}\end{matrix}\right\}\begin{matrix}CH_2I\\ CH_2\\ COHO\end{matrix}$$

We know, therefore, the radicals of adipic acid and their arrangement if we possess the same knowledge with regard to iodopropionic acid.

The above elegant synthesis has lately been performed by Professor Wislicenus of Zurich. M. Berthelot has now succeeded in producing representatives of the principal classes of hydrocarbons from the elements of carbon and hydrogen, and Messrs. Bauer and Versow of Vienna have prepared from amylene, C_5H_{10}, a compound, $C_{10}H_{16}$, which appears to be identical with terebene, a body closely allied to turpentine.

Another way to determine the proximate constituents of molecules is to take the little structures to pieces, and to form a judgment of their constitution from the radicals which thus can be extracted. This plan has been adopted by Mr. Chapman, and described by him at one of our former meetings.

The more common and more reliable method for the determination of the grouping of atoms in molecules is, however, the replacement of one or more of them by atoms of another kind, and the careful examination of the properties of the bodies thus formed. M. Gautier has recently obtained a new substance of the same composition as acetonitrile, which he calls methcarbylamine. According to their formation, acetonitrile, as well as methcarbylamine, can be considered as combinations of cyanogen and methyl $=CH_3CN$. The two bodies, however, do not possess the same properties. If they are heated with potassic hydrate and water, methcarbylamine produces formic acid and methylia, whereas the same reagents cause acetonitrile to form acetic acid and ammonia. Thus—

$$\underbrace{C_2H_3N}_{\text{Acetonitrile.}} + \underbrace{2H_2O}_{\text{Water.}} = \underbrace{C_2H_4O_2}_{\text{Acetic Acid.}} + NH_3$$

$$\underbrace{C_2H_3N}_{\text{Methcarbylamine.}} + 2H_2O = \underbrace{CH_2O_2}_{\text{Formic Acid.}} + \underbrace{N\left\{\begin{matrix}CH_3\\ H_2\end{matrix}\right.}_{\text{Methylia.}}$$

In the first case, the radical methyl remains after the decomposition in union with carbon, and in the second case in combination with nitrogen. Accordingly, it is supposed that the same arrangement prevails in the undecomposed molecules, and with this supposition all the other properties of methcarbylamine and acetonitrile agree. In symbols these relations are expressed as follows:—

$$N\left\{\begin{matrix}C''\\ CH_3\end{matrix}\right. = \text{methcarbylamine.}$$
$$N\left\{\begin{matrix}\\ C_2H_3\end{matrix}\right. = \text{acetonitrile.}$$

This case of isomerism is most interesting, inasmuch as it furnishes a most instructive lesson on the grouping of atoms. The homologous bodies of methcarbylamine in the ethyl and propyl series have also been obtained.

Isomerism, indeed, has received much attention during the last year, and a great many interesting discoveries have resulted. Of these, one more example may be mentioned. We know two compounds of the formula CN_2H_4O—the one is ammonic cyanate, and the other urea. Until recently, only one corresponding sulphur-compound, ammonic sulphocyanate, was known. Professor Reynolds has succeeded in obtaining the true sulphur-urea, a body isomeric to ammonic sulphocyanate.

Thus every year produces results which improve our conceptions of the atomic and molecular constitution of

bodies. And, as our knowledge improves, new questions suggest themselves, and our power over the elements increases. It has already become possible to prepare, in the laboratory, bodies of a very complex character, and which, a few years ago, were only found in the bodies of animals or plants.

Alizarine, the beautiful compound of the madder root, has been obtained, by artificial means, in the course of the year, by MM. Liebermann and Græbe. Results of such a nature render it highly probable that, at no distant period, it will be in our power to render nearly all, if not all, the substances found in plants and animals. Here I must not be misunderstood. Organic structures, such as muscular fibre, or the leaves of a tree, the science of chemistry is incapable of producing; but molecules like those found in a leaf, or in the stem of a tree, will, no doubt, one day be manufactured from their elements.

I must not conclude this address without reference to two or three papers of great importance.

Professor Bunsen, of Heidelberg, has published a paper on the washing of precipitates. Every one acquainted with practical chemistry knows how much time is often lost in waiting for a liquid to pass through a filter. Bunsen found the rate of filtration nearly proportional to the difference between the pressures on the upper and lower surfaces of the liquid. If, accordingly, the funnel be fixed air-tight, by means of a perforated cork, to the neck of a bottle, and the air exhausted in the bottle, the liquid will run faster through the filter in proportion to the diminution of the pressure in the bottle. Comparative experiments, some made according to the old, and others according to the new method, showed that the filtration, washing, and drying of the precipitate, which took seven hours by the old plan, could be performed, by filtration into an exhausted bottle, in thirteen minutes. But a saving of time is not the only advantage of the improved method of collecting and washing precipitates. A more perfect washing, with less water than is required by the common way of proceeding, is by no means the least recommendation of Bunsen's ingenious method.

A very important paper has been published by Professor Liebig, on the improvement of the nourishing qualities of bread. Certain quantities of phosphates and other salts form necessary ingredients of wholesome food. Now, it is well known that most of these salts, which are naturally in wheat, remain with the husk. Liebig proposes to add salts, of a nature similar to those remaining in the husk, to the flour, and, at the same time, to substitute, for the carbonic acid developed by fermentation, gas liberated from iodic carbonate. The bread prepared according to Liebig's recommendation is said to be of excellent quality, and to exceed bread made by the common plan in value.

Mr. Graham, of Her Majesty's Mint, has continued his researches on the absorption of hydrogen by palladium. Palladium appears to be able to absorb more than 900 times its volume of hydrogen, and to form a combination which consists of nearly equal equivalents of the two elements. Hydrogenium, as Mr. Graham calls the combined hydrogen, acts in this case like a metal, and thus the opinion held by some scientific men, that hydrogen constitutes the vapour of a metal, receives confirmation. The specific gravity of hydrogenium, as contained in the alloy, was found to be 1·95. These experiments are remarkable in more than one respect. The palladium which absorbs and combines with the hydrogen, does not change its state of aggregation, but remains solid, and expands, as if it had been heated. The nodules of the palladium have, consequently, changed their relative positions, and combined with hydrogen, whilst the continuity of the metal remained intact.

The last paper to which I have to draw your attention, is to the beautiful paper by Professor Tyndall, on a new method of decomposing gaseous substances by means of light. Tyndall's experiments bring us face to face with the motions of atoms of molecules, and the relation of these motions to chemical decomposition. They will, no doubt, at some future time, furnish valuable materials to chemical dynamics.

ON THE

METHODS OF ANALYSIS

AND THE

COMPOSITION OF VARIOUS CHEMICAL MANUFACTURING PRODUCTS.

By M. GASTON TISSANDIER.

(Continued from p. 76.)

Chlorides of Potassium.

Commercial chlorides of potassium, or muriates of potash, contain sulphates, and frequently alkaline carbonates also; in certain cases a more or less considerable proportion of chloride of sodium is also found in them.

Method of Analysis.—Weigh 25 grammes of the muriate of potash to be tested, and dissolve them in a beaker; filter the solution to separate the insoluble matters, which usually occur only in very small proportion, and dilute it with water to the volume of ½ a litre.

Alkalimetric Standard.—This does not generally exceed 1° or 2°; for obtaining it, decant 100 c.c., corresponding to 5 grammes: ascertaining previously that the solution is alkaline, for it is possible that the muriate may not contain any alkaline carbonates.

Sulphuric Acid.—The sulphuric acid is estimated in 100 c.c. (5 grammes) by means of chloride of barium.

Chlorine.—The estimation of the chlorine is of great importance, and should be rigorously exact: take 10 c.c. of the filtered liquid tared to ½ a litre, and determine the amount of chlorine by means of a standard silver liquid. For greater exactness, it is a good plan to verify this estimation by directly weighing the chloride of silver precipitated in another experiment. Measure 10 c.c. (0·50 gr.) of the solution of muriate, and transfer them by means of a pipette into a beaker holding 500 c.c.; add a large quantity of boiling water, acidulate it with pure nitric acid, and precipitate the chlorine by a slight excess of nitrate of silver. The estimation previously made by means of the standard solution allows the quantity of nitrate of silver required to be calculated, so that the excess may not be great. The precipitate is well stirred with a glass rod, and the warm liquid settles so well that it is possible to wash the precipitate of chloride of silver by decantation with boiling water. When the washing water is not clouded on the addition of a drop of chlorhydric acid, it is thrown on a small filter, left to drain, and dried at 100°.

The desiccated precipitate is detached from the filter, which is calcined in a small tared porcelain capsule, and when the paper is burnt, the chloride of silver precipitate must be added and partially melted; it is then cooled, and the capsule weighed together with the chloride of silver; the weight of the precipitate is thus obtained by difference. The chloride of silver adheres closely to the capsule. In order to remove it, throw the whole into a glass, and place on it a piece of zinc, sulphuric acid, and water; the chloride of silver, partially reduced, will then separate from the capsule.

Potassium.—The estimation of potassium is effected in the same way as in the case of crude salts (see Chemical News, vol. xx., p. 73), by means of bichloride of platinum, working upon 10 c.c. (0·50 grms.)

Water.—The proportion of water is ascertained by heating, in a platinum crucible, a given weight of the muriate to be tested. A closed tube is still better, as it

allows the loss from projections arising from the deflagration of the salt to be more easily avoided.

Calculation of the Analysis.—Part of the estimated potassium is combined with the sulphuric acid contained in the sulphate. If the excess of potassium is sufficient to combine with the whole of the chlorine, the latter is transformed into chloride of potassium; if not, the quantity of chlorine necessary to form chloride of potassium with the remaining potassium is calculated, and the excess of chlorine reckoned as chloride of sodium.

Composition of Commercial Muriates.

1. *Muriates containing Alkaline Carbonates.*

Substances estimated.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
Moisture	4·27	6·68	5·00	1·01	1·38	3·69	6·35	15·06
Insoluble matter	0·32	0·22	0·10	0·18	0·28	0·41	0·90	0·09
Sulphate of potash	12·31	9·45	12·31	5·50	4·01	14·18	11·81	11·62
Chloride of potassium	79·80	80·00	77·20	92·39	93·52	80·92	75·01	59·41
Carbonate of potash	1·00	3·25	3·10	0·92	0·61	0·49	3·28	13·82
Carbonate of soda	2·10	—	2·01		—	—	2·13	
Non-estimated and loss	0·20	0·40	0·28	—	0·20	0·31	0·52	—
Total	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
	MM. Vorster and Grüneberg, at Cologne.				M. P. Rohée, at Bordeaux.		M. A. Lefebvre, at Corbehem, near Douai.	

2. *Muriates containing Chloride of Sodium.*

Matters estimated.	I.	II.
Moisture	3·09	1·50
Insoluble substances	0·11	0·20
Sulphate of potash	0·81	4·61
Chloride of potassium	80·15	78·40
Chloride of sodium	15·01	14·09
Carbonate of soda	0·72	1·12
Non-estimated and loss	0·11	0·08
Total	100·00	100·00
	MM. Campion and Therould, at Granville.	

NB. These sulphates proceed from a manufacture of iodine from kelp.

3. *Muriates Containing neither Chloride of Sodium nor Carbonates.*

Substances estimated.	I.	II.	III.
Moisture	1·20	3·63	3·50
Insoluble matter	0·31	0·21	0·30
Sulphate of potash	6·90	11·86	4·55
Chloride of potassium	91·50	84·20	91·65
Non-estimated and loss	0·09	0·10	—
Total	100·00	100·00	100·00
		M. Paisant, jun., at Pont-l'Abbé (Finisterre).	

Chloride of potassium is obtained, as has been shown, from the beet-root salts; it is also extracted in abundant quantities from the ash of seaweed. The newly-discovered deposit at Stassfurt yields considerable quantities; and large kidney-shaped pieces of pure chloride of potassium have been found in abundance in the midst of that vast salt mass. We have repeatedly analysed this natural chloride of potassium (called by the Germans sylvin), and have never discovered more than 1-10th of foreign matter. Every sample which we examined contained from 80 to 99 per cent of chloride of potassium. This is a highly important fact; and it is well known that the influence of the exportation of the Stassfurt products is already making itself felt in the manufacture of potashes.

(To be continued).

The Laboratory of the London Institution.—We understand that Professor Wanklyn has recently been elected a corresponding member of the Munich Academy of Science.

NOTICES OF BOOKS.

Exeter Change, for the British Lions. Edited by Snug the Joiner. London: B. Pardon and Son, Paternoster Row. 1869.

The British Association for the Advancement of Science meets this year, as all the world knows, at Exeter. Exeter Change, as all the world—specially the younger portion of it—does *not* know, was once one of the sights of London; for therein were housed the British Lions which had whilom dwelt in the Tower of London, and, symbolising the sovereignty of this realm, had been considered necessary appurtenances of Royalty. "Exeter Change," says the editor of the pamphlet before us, "has disappeared, and the ground hallowed by memories of the caged lions; and the solitary beadle is now occupied by the Gaiety Theatre. Need I add that my title-page is deeply significant. You British Lions have now an Exeter Change productive of gaiety."

"Exeter Change" is not a satire; it has nothing of the lampoon about it; the sarcastic Roman Pasquino would scarcely allow it to be called a pasquinade; there is nothing in it the least bitter or spiteful, nothing that smacks of the *Tomahawk*, or *Queen's Messenger*. The mention of an individual is generally accompanied by his laudation, or, if the reverse, the censure is no more than the most harmless "chaff." What, then, shall we call it? A parody? Scarcely. A squib? By no means. A burlesque? This is nearer the mark; particularly if we may trace the word through the Italian *burlesco*, and the Low Latin *burleschus*, to the classical *burra*, as Mr. Donald tells us; but Ainsworth is silent about *burra*, and approaches it no more nearly than *burra*, which signifies "the hinder part of a plough," and is scarcely appropriate. What, then, remains to us? A travesty? That will do better. "Exeter Change" is a sort of travesty; or, if the reader pleases, he may find in it just a *soupçon* of several of the above forms of composition.

Having defined our work, let us look more closely into it. In the "Prologue," the editor greets the various presidents of sections and learned bodies of the British Association, and states the object and aim of his work. This is followed by a "History of the Association," written in the exact and somewhat prosaic style of certain students of the Buckle School. Then comes the "Wail of the Mathematician," a poem in imitation of "Locksley Hall," which is clever, and shall speak for itself—albeit in a somewhat *staccato* manner. The mathematician here describes the progress of his courtship:—

"Once about the beach we wandered, spooning in a way sublime,
While the dreary tales of Science were reserved for future time;

When geologists before us on contorted strata prosed,
We were sure to find a seaweed in a place not much exposed."

. . . . . .

"At the time when Dr. Hooker the Darwinian standard raised;
At the time when sharp Miss Becker got herself unduly praised;
At the time when Father Secchi fraternised with prelates grave;
Then it was that I discovered I was simply Kitty's slave."

Determining to discard this fickle Kitty, the mathematician tries to find some strong-minded woman—

"Iron-visaged, tall, snd skinny, she the bluest of the blues,
Shall with potent mathematics my domestic life suffuse.
Dingy black shall be her costume: pins shall take the place of hooks:
And her hair, close-cropped, shall startle followers of fashion books."

The poem is followed by a long article on "The Development Hypothesis," a travesty of some recent animadversions of the German anti-Darwinites. "On some Recent Spectral Observations" follows this. Herein a man is supposed to fall asleep in his library, and to see a vision of the various authors of the books around him, and to hold a short conversation with them: the following extract is taken from the concluding portions:—

"But there now arose such a clamour that I could not hear myself speak. Albertus Magnus *would* keep striking Avicenna with a crozier; Cardinal Bellarmine threw his hat at Galileo; Abelard tripped up William of Champeaux; the pretty little Heloise flirted with Peter of Cluny; while a host of Plenists, headed by Father Linus, were having a set fight with a host of Vacuists, headed by Robert Boyle."

Next we have "Mercurius Rex"—a chemical ode. Recitative and air, with accompaniments of Maëlzel's metronome, contrabassos in F in altissimo, Helmholtz's double syren, and the tibia pastorale.

In the next article—"On the Alcoholic Compound termed Punch," by John T—nd—ll, LL.D., F.R.S.—we have a capital imitation of the style of a certain eminent lecturer and physicist. Let us content ourselves with the last two paragraphs—

"Experiment has proved that the juice of three or four lemons, and three-quarters of a pound of loaf-sugar dissolved in about three pints of boiling water, give saporous waves which strike the palate at such intervals that the thrilling acidity of the lemon-juice and the cloying sweetness of the sugar are no longer distinguishable. We have, in fact, a harmony of saporific notes. The pitch, however, is too low, and to heighten it, we infuse in the boiling water the fragrant yellow rind of one lemon. Here we might pause, if the soul of man craved no higher result than lemonade. But to obtain the culminating saporosity of punch, we must dash into the bowl, at least, a pint of rum and nearly the same volume of brandy. The molecules of alcohol, sugar, and citric acid collide, and an entirely new series of vibrations are produced—tremors to which the dullest palate is attuned.

"In Punch, then, we have rhythm within rhythm, and all that philosophy can do is to take kindly to its subtle harmonies. It will depend in some measure upon previous habits, whether the punch when mixed will be taken in excess or in moderation. It may become a dangerous ally of gravity and bring a sentient being to the gutter. But, on the other hand, it may become the potent inner stimulus of a noble outward life."

The remainder of the pamphlet is filled with shorter articles:—An "Alphabet for Young Associates;" "Rejected Addresses," giving a list of certain supposititious papers rejected by different Sections;" Advice "To the Dyspeptic Members of the Association," containing a *menu* in which we notice "Goujon sauté en l'eau froide;" "Poulet pansu;" "Porc à la trichine;" "Xéres de Hamburg nouveau et brûlant;" and "Vin d'Oporto des environs de Spital-fields."

"Eozöon Canadense: a lay of Chivalry from Section C" is a poem of twenty-one stanzas; "What will they do with it?" an account of a meeting in the Albert Hall of Arts and Sciences" in 1872, when a grand difficulty has arisen as to what use the Hall shall be applied to, and various *savants* express their various opinions. Then we have a letter from Francis Bacon, headed "Elysian Fields, August 15th, 1869," in which, in the quaint English of the early part of the seventeenth century, Bacon refers to his treatise "Nova Atlantis," and shows that he therein shadowed forth such an Association of the learned as we now have in the British Association for the Advancement of Science.

Altogether, "Exeter Change" is very readable. There is not much wit in it, but it is pleasant and lively, and never gross or coarse, nor do we detect any *doubles entendres*, too often the vehicle for raillery and sarcasm, and sometimes for what is worse. It is evidently the work of young writers; and it is equally evident that the matter has been struck off rapidly, without much elaboration, and this we consider an advantage, for, by the means, we get fresh, budding ideas, in the place of garish and dressed-up piracies. We wish Snug the Joiner, and his colleagues, Peter Quince and Nick Bottom, every success; and we commend their trim little work, not alone to members of the Association, but to their scientific *confréres* who have not journeyed to Exeter.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

The Journal of the Franklin Institute, June, 1869.

A large portion of this excellent periodical is devoted to engineering facts. Among the original communications relating to chemistry we find:—

Sugar and Starch from Sweet Potatoes.—M. H. Bartol presented, at the last meeting of this Institute, samples of sugar and starch, and the following analysis made in November last, from the juice of North Carolina sweet potatoes (per cent):—Sugar, 10·50; starch, 6·00; various salts, 1·17; gum, &c., 0·33; water, 82·00. By the use of powerful presses, 90 per cent of the weight of the potato can be obtained in juice; the density of this juice is 10° Beaumé=1·075 sp. gr. These potatoes, the author says, will yield 6·18 per cent of sugar and 5 per cent of starch; but, by improved culture, as evidenced in Europe in the instance of beet-root, this quantity may be largely increased.

Tin in Missouri.—M. Williams.—This gentleman, in a note addressed to the editor of the above periodical, states that the granitic rocks of south-east Missouri are all more or less charged with stannic acid, so that there is a fair prospect of obtaining tin ore in quantity in that country.

The larger number of papers of this number relate to engineering and astronomy, rather than to chemistry or sciences allied therewith

American Journal of Pharmacy, July, 1869.

This periodical contains a very large amount of excellent matter, but most of it belongs too strictly to pharmacy to be suited for our pages We abstract the following papers:—

Bicarbonate of Ammonia as a Pharmaceutical Preparation.—W. Procter, jun.—The author begins by stating that he has used this salt as an antacid, instead of bicarbonate of soda, above which it is preferable, owing, also, to its somewhat stimulating powers. As to the formation of this salt, the author says—It is well known to druggists that considerable quantities of this salt are formed on the sides of casks in which carbonate of ammonia is imported, and other portions are derived from the accidental or careless exposure of the sesqui-carbonate of ammonia, whereby an equivalent of mono-carbonate is lost. It has been usual to reserve the salt thus obtained for forming acetate, nitrate, or other ammoniacal salts; but it is rarely used medicinally on its own merits. If it were sufficiently abundant or

could be prepared cheaply by a direct process, it would form the best yeast powder that can be offered, since it contains a larger portion of carbonic acid than any of the alkaline bicarbonates except that of lithia, which is, of course, unsuited to this use. Bicarbonate of ammonia in its purest state is a white salt, isomorphous with bicarbonate of potassa, and possesses the same crystalline form; its composition is expressed by the formula $NH_4O_2CO_2.HO$; its taste is saline, with a slight ammoniacal impression, and is slowly volatile when exposed, and gradually evaporates with a slight odour of ammonia; it is soluble in eight parts of water at 60° F., and its aqueous solution exhibits an alkaline reaction with syrup of violets; it is decomposed by the heat of boiling water, giving off carbonic acid; it is nearly insoluble in strong alcohol, but soluble in 60 parts of dilute alcohol; it is readily prepared on the small scale, by dissolving out the mono-carbonate from the powdered sublimed sesqui-carbonate (which consists of one equivalent of each salt) by means of alcohol of 85 per cent, in which the bicarbonate is almost insoluble. When a saturated solution of sesqui-carbonate of ammonia in water is saturated with CO_2, a quantity of the bicarbonate separates in crystals, owing to its less solubility.

Sweet Quinine.—W. Procter, jun.—It appears that, under this name, there has been thrown into commerce, by M. F. Stearns (U.S.), an article which, according to a statement made in the manufacturer's circular, appeared to be quinine associated with liquorice sugar. The author of this paper very properly states that the article in question, having been submitted by him to chemical tests, does not contain any quinine at all, but mainly cinchonine, precipitated from the sulphate, dried and triturated with an impure glycyrrhizin prepared from liquorice root. The tastelessness of "sweet quinine" is due to the very difficult solubility of cinchonine, which requires nearly 4000 parts of cold water; with acid or alcoholic fluids, which salify and dissolve it, its bitterness becomes apparent.

The remainder of the papers of this excellent periodical are not suited for abstraction in our pages, for the reason already given.

Bayerisches Industrie und Gewerbeblatt, June, 1869.

This number contains, besides a large collection of official communications, among which is a well-digested and arranged law for limited liability companies, the following original papers:—

Utilisation of the Waste Products of Soda and Bleaching Powder Manufacture.—M. Züngerle.—The contents of this paper are, in some form or other, known to our readers, as this subject has been fully treated of in our columns. This paper does not teach us anything new, and therefore we quote nothing more from it than this—that, in Germany, the manufacture of sulphur from soda waste, and of peroxide of manganese containing 60 per cent, is carried out largely, and with success.

Use of the Miesbach Coal as Fuel at the Salt-work of Hall, in the Tyrol.—M. Hailer.—This paper is chiefly of local importance but it may be noticed that the coal here alluded to, while containing 18·6 per cent of ash, and being chiefly small coal, containing, on an average, 52 per cent of carbon, is yet successfully applied to heat the salt-pans, at almost nominal cost, since the furnace is so arranged as to get the most heat from the fuel.

Jet-Black China Varnish.—M. Marx.—Under the above name is sold a varnish for boots and shoes, which, according to the author's analytical researches, chiefly consists of an alcoholic solution of shellac. According to the author, an excellent imitation of the original may be made by dissolving 10 grms. of shellac, and 5 grms. of turpentine, in 40 grms. of strong methylated spirits, in which fluid should be previously dissolved 1 grm. of extract of logwood, with some neutral chromate of potassa and sulphate of indigo. The varnish is to be kept in well-stoppered bottles.

Parisian Copying Ink.—M. Marx.—To make this, take 30 grms. of extract of logwood, and 7·5 grms. of crystallised carbonate of soda; boil this with 240 grms. of water, and add, while vigorously stirring, 30 grms. of glycerine. When the fluid has become cold, dissolve in it 1 grm of neutral chromate of potassa, and add, lastly, 7·5 grms. of gum arabic, previously made into a thick mucilage with water. The paper upon which it is desired to transfer a copy need not be moistened if this ink is used.

Mixture for Producing "Japanese Lightning."—M. Marx.—Anhydrous saltpetre (nitrate of potassa), 33·3 parts; charcoal from lime-tree wood, 58·3; flowers of sulphur, 8·4. As to the name of Japanese lightning, it means the same as the Japanese matches Prof. A. W. Hofmann spoke about a couple of years ago, at a meeting of the Chemical Society.

Zeitschrift für Chemie, von Beilstein, No. 13, 1869.

This number contains only one original paper, the great bulk being abstracts from various periodicals written and published in English, French, Italian, and German languages. The original paper alluded to is on—

Hæmatoxyline and Hæmateine.—Dr. Tabensky.—The author states that, since MM. Erdmann and Hesse had discovered that hæmatoxyline reduces solutions of silver and becomes coloured red by the action of direct sunlight, he was induced by Prof. von Babo to make some experiments in order to discover whether the alcoholic extract of logwood might not be very serviceable in photography. For this purpose the author prepared hæmatoxyline in pure state according to Erdmann's method, taking care to re-crystallise the substance repeatedly from an alcoholic solution. Next, two glass plates, properly prepared, were exposed, in a photographic apparatus, to light, and afterwards one of these plates was treated, as usual, with pyrogallic acid, the other with a solution of hæmatoxyline. The success of the latter operation left nothing to be desired, and the further experiments of the author leave no doubt whatever that hæmatoxyline may be advantageously applied in photography. The quantities best suited for this solution are as follows:—Hæmatoxyline, 0·5 grm.; distilled water, 80 grms.; 22 grms. of acetic acid of 33° strength; and a small quantity of glycerin. The method of preparation of hæmateine has been altered and improved by the author of this paper in the following manner:—By means of an aspirator, air is drawn through a bottle filled, for one-third of its capacity, with liquid ammonia; and the current of air thus charged with ammonia is made to pass slowly over and through hæmatoxyline suspended in water; but care is to be taken that the glass tube through which the air charged with ammonia strikes should only just dip very slightly under the surface of the water; by this means, excess of ammonia is excluded, and the formation of amorphous brown substances is prevented. By this method, from 10 to 12 grms. of hæmatoxyline are changed, within three hours, into hæmateine, yielding a magnificently purple-coloured solution, which is precipitated by bisulphite of ammonia when cold; but, on heating, this precipitate becomes re-dissolved. Hæmatoxyline is, according to M. Hesse, composed of $C_{32}H_{14}O_{12}+2HO$; hæmateine is $C_{32}H_9O_9+HO$. The former substance is a very weak acid, rather difficultly soluble in water, but very readily in an aqueous solution of borax; it is best and easiest prepared from the extract of logwood met with in commerce.

On Dichloraldehyde.—M. E. Paterno.—This paper, being taken from an Italian periodical which does not come to England, is therefore abstracted. The author states that he treated dichloraldehyde with chloride of phosphorus, with the view thus to obtain the chloride $CHCl_2—CHCl_2$; but this was not the result of the reaction between the two substances just named: a product was obtained which boils at 250°, and which, on being submitted to elementary organic analysis, gave results leading to the formula $C_4H_4Cl_6O$. The constitution of this substance is apparently that of an ethyliden-oxychloride, the composition of which is to be indicated by either of the two following formulæ:—

$$CHCl_2—CH_2—O—CCl_2—CHCl_2,$$

or by—

$$CHCl_2—CHCl—O—CHCl—CHCl_2.$$

The substance, $C_4H_4Cl_6O$, is a somewhat coloured oil, heavier than water, soluble in alcohol and ether, boiling at 250°, and giving off very irritating acid fumes; on being mixed with an alcoholic solution of caustic potassa, a very violent reaction ensues, and, on addition of water, an aromatic-smelling oil is separated, which boils at 196°, and has the formula $C_4H_4Cl_4O$. This substance combines readily with bromine, forming a solid crystalline substance fusing at 60°, and having for its formula $C_4H_3Cl_4Br_4O$. Dichloraldehyde is not readily oxidised; when its vapour, mixed with air, is passed through a tube containing spongy platinum, no perceptible change ensues; mixed with its own bulk of red fuming nitric acid, a very energetic reaction sets in; when this has somewhat subsided, and the excess of nitric has been expelled by evaporation, and the residue is submitted to distillation and rectification, dichloracetic acid is obtained, which boils at about 195°, and yields, when distilled with a mixture of concentrated sulphuric acid and alcohol of 90 per cent, pure dichloracetic ether boiling at 155°.

Crystallised Digitaline.—M. Nativelle.—This alkaloid is obtained in crystalline state in the following manner:—100 parts, by weight, of coarsely-powdered *herba digitalis* is mixed with a solution of 25 parts of acetate of lead in 100 parts of water, left standing for twelve hours, and then exhausted with water; the residue is treated with alcohol of 50° until the solution thereof is free from any taste. The solution thus obtained is treated with a solution (aqueous) of four parts of acetate of lead, and filtered. To this filtrate is next added a solution of two parts of phosphate of soda, again filtered, and the alcohol removed by distillation on a water-bath. It will be observed that, in the residue of the distillation, there are suspended, in the aqueous fluid, small crystals, surrounded by a yellowish-coloured, very bitter-tasted substance. The residue of the distillation is concentrated, by evaporation on a water-bath to about ten parts, next filtered, washed with cold water, the precipitate dried by pressing it between folds of filtering paper, dissolved in about twice its weight of alcohol of 60 per cent, and put by in a cool place. While thus standing, two different sets of crystals are separated—first, those of an inactive substance; next, after some days, yellowish-coloured crystals of digitaline. After these have been fully formed, the mother liquor is run off, and the crystalline mass is taken up with alcohol of 80 per cent, while, at the same time, some animal charcoal is added. The solution, having been filtered and left to evaporate, is treated with pure chloroform, and strongly shaken up with it; the digitaline only is dissolved. On distilling off the chloroform, a somewhat coloured digitaline is obtained, which is further purified by repeated treatment with alcohol and animal charcoal. The crystalline digitaline is a neutral, non-nitrogenous, inodourous substance, of very bitter taste, readily soluble in chloroform, while one part of this digitaline requires twelve parts of alcohol of 90 per cent for its solution at the ordinary temperature; it is slightly more soluble in boiling alcohol, but far less soluble in absolute alcohol and in pure ether, and, practically, entirely insoluble in water at any temperature. Sulphuric acid dissolves this substance, yielding a greenish-coloured solution, which, on contact of vapours of bromine, becomes *groseille* red coloured; but addition of water restores the original green colour. Hydrochloric acid, also, dissolves digitaline, exhibiting, likewise, a green solution, from which water precipitates a resinous matter. The result of the elementary organic analysis of digitaline led to the formula $C_{28}H_{40}O_{14}$. The other crystalline substance above mentioned is insoluble in chloroform, soluble in alcohol;

crystallises in colourless needle-shaped crystals which are devoid of taste, neutral to test-papers, free from nitrogen, less soluble in alcohol than digitaline, and practically insoluble in water and ether. With sulphuric acid, this substance yields a *groseille* red coloured solution, which turns yellow on addition of water; nitric acid dissolves this substance to a colourless fluid, while hydrochloric acid is hardly capable of dissolving it at all. There is no elementary organic analysis as yet made of this substance, but it has been ascertained to be free from nitrogen.

Polytechnisches Journal von Dingler, first number for July, 1869.

This number contains the following original papers:—

On Stoves suitably constructed to Burn Coal as Fuel for Heating Rooms in Dwelling-Houses.—M. W. Hobbach.—The author describes, at length, an excellently arranged stove, by the use of which economy of fuel and proper supply of fresh air to the room are secured. A stove of medium size is so arranged that with from 15 to 20 lbs. of coal, a room of 12,000 cubic feet capacity is kept heated to 16° Réaumur (=20° C., and 68° F.) for from eight to twelve hours. The construction of this stove could not be well understood without the reproduction of the engravings accompanying the original.

Chemical Composition of Native Chrome Iron Ore.—M. Clouet.—After referring to the kinds of rock wherein this ore occurs, the author states that all varieties of chrome iron ore which have been hitherto analysed exhibit a constant and definite chemical composition. As instances, he quotes the following analysis:—$FeOCr_2O_3$, Russian ore, as, also, Smyrna and Norway (Drontheim); $2FeO,Cr_2O_3$, Ile à Vaches, St. Domingo; $2FeO,3Cr_2O_3$, Russia (another district); $4FeO,5Cr_2O_3$, the Banat (Alt-Orsowa); $8FeO,5Cr_2O_3$, India; $6FeO,5Cr_2O_3$, California; $3FeO,2Cr_2O_3$, Australia. A sample of pure crystalline octahedrical ore from the Ile à Vaches was found by the author to consist, in 100 parts, of—Oxide of chromium, 51·53; protoxide of iron, 48·46. Formula, $2FeO,Cr_2O_3$. The author enters, at great length, into particulars about the analysis of chrome iron ores; but, since any good treatise on analytical chemistry may be consulted on this subject, we do not notice this part of his paper here any further.

Manufacture of Hyposulphite of Soda from Soda Waste.—M. Schaftner.—This paper is entirely a lengthy description of a manufacturing process on the large scale. The main facts are—that, to the soda waste, sulphate of soda is added; and, after this mixture has been exposed for some time to the influence of the air, it is lixiviated with water. Sulphur is obtained as a by-product.

Contribution to our Knowledge of the Relation of Carbon to Oxygen.—Dr. Richters.—This paper is far too lengthy for any useful abstraction. The chief point thoroughly elucidated by the author is the oxidation of coal, charcoal, and coke at comparatively low temperatures.

On Balata.—M. Sperlich.—Balata is the inspissated milk-juice of the *Sapota muelleri*, a tree met with in large numbers in the three Guianas. Balata appears to hold a middle place between caoutchouc and gutta-percha. The author obtained the raw material, and, after having first treated it with boiling acidulated water, next with absolute alcohol, he dried the substance, and next dissolved it, with the aid of gentle heat, in sulphide of carbon. After removing that fluid by distillation, the balata was repeatedly boiled with a mixture of ether and alcohol, well dried and submitted to elementary analysis, yielding, in 100 parts, 88·49 of carbon and 11·37 of hydrogen, and, therefore, pretty nearly the composition of purified gutta-percha, which gives 87·91 of carbon, and 11·94 of hydrogen.

Use of Maize (Indian Corn) for Distillation of Spirits in Hungary.—Dr. Schultze.—This paper is chiefly written for distillers. The use of maize is a good idea. Curiously enough, experience appears to have taught that this grain requires, after having been ground to meal, to be steeped for about twenty-four hours in water containing sulphurous acid gas in solution. The next operation is the boiling of the meal, after which it is, when sufficiently cool, mixed with green barley malt. The quantity of spirits obtained from this material is large, and the quality good.

Alloys for Bells.—M. Lichtenberger.—It appears that for some time there have been met, in the trade in Germany, clock-bells of excellent and loud silvery tone; the author of this paper was induced, therefore, to analyse—(1) the metal the bell of a large-sized house-clock is made of, (2) a smaller bell, (3) bells for horse-harness, and (4) an ordinary small yellow-metal bell; the results are as follows:—

	No. 1.	No. 2.	No. 3.	No. 4.
Copper	83·22	83·09	84·50	79·90
Tin	16·76	16·80	15·42	20·03

The Nos. 1 to 3 are from the same manufactory.

New Method of Bleaching Feathers.—M. Duflot.—This process is an entirely newly-discovered one, whereby the feathers of ostriches and other birds may be bleached, even if these feathers are naturally black or dark grey-coloured. The feathers are placed for from three to four hours in a tepid dilute solution of bichromate of potassa, to which, cautiously, some nitric acid has been added. After this lapse of time, the feathers will be found to have assumed a greenish hue, owing to the oxide of chromium precipitated on the substance; in order to remove this, the feathers are placed in a dilute solution of sulphurous acid in water, whereby the feathers become perfectly white and bleached. Care is to be taken that the solution of bichromate be not made too strong, and, especially, that not too much nitric acid be used, which would cause an irremovable yellow colour.

Annales du Génie Civil, July, 1869.

This number does not contain any papers or communications relative to chemistry, but we learn from it the—

Abolition of Patents for Inventions in the Netherlands.—A law has been made cancelling the old patent law of 1817; and, though all existing patents remain in force, no new ones are to be any more granted from and after the 1st day of August, 1869.

Moniteur Scientifique, August 1, 1869.

This number contains the following original papers:—

On the Cooling Down of the Sun.—M. Lecoq.—This is a very lengthy, and rather speculative treatise on a subject partly belonging to astronomy and partly to physical geography. The author deserves great credit for the lucid manner of his exposition; but we cannot enter into details on this matter, however interesting it may be.

Quantity of Heat Developed in Interrupted Electric and Galvanic Currents.—MM. Jamin and Roger.—A purely mathematico-physical paper.

On Toluol and the Alkaloid it Yields.—M. Rosenstiehl.—The greater part of the contents of this paper have been previously published, and have been quoted by us from another periodical: but we translate the last few lines of this publication for the practical value therein contained:—"Toluol is a unique and peculiar hydrocarbon, which, on being treated with nitric acid, yields, simultaneously, two nitro-derivatives (the manufacturer who desires to obtain alkaloids, in order to prepare therewith colouring matters, should take care to produce as little crystallised nitrotoluol as possible). The isomerism manifested after the action of nitric acid is maintained in its coloured derivatives. Although the two toluidines differ, as regards their chemical properties, they yield colouring matters the physical properties of which are identical. The fact of the existence of isomerism of the artificial colouring substances explains the large number of varied blue and violet matters obtained from fuchsine; this may lead to the discovery of a large number of isomers of one and the same colour; and this subject I intend to take up, experimentally, within a short time.

Fusible Alloys.—M. Stewart mixes 7·5 parts of bismuth, 4 of lead, 1·5 of tin, and 2 of cadmium, and thus produces an alloy fusing at 66°. We quote hereunder the composition of divers fusible alloys, respectively, so made that the quantity of bismuth of each is the same:—

	Newton's Alloy.	D'Arcet's Alloy.	Pelouze's Alloy.	Wood's Alloy.
Bismuth	600	600	600	600
Lead	375	300	360	320
Tin	225	300	240	160
Cadmium	—	—	—	120
	1200	1200	1200	1200

All these alloys fuse below 100°.

Under the title of—

What is Going on in Germany, we find in this periodical an excellent account briefly summarising the history, progress, and present state of the Prussian universities. The most ancient of these is that of Griefswald, founded in the year 1456; the youngest is Bonn, founded in 1818. Leaving the Austrian dominions altogether out of the question, Germany, that is to say, the North German Confederation and the Southern Independent German States, contain together 19 universities, with 773 ordinary, and 340 extraordinary professors, and 342 repetitors, and, collectively, frequented by an average of 14,383 students. Some of these institutions have large revenues; foremost among these is Tübingen, Wurtemberg, with an annual revenue of 100,000 florins (about £10,000). All of these universities are under government control, and the expenses are met by regular grants made with great liberality. The population of this portion of Germany amounts to about 36,000,000, and the area, in German geographical square miles, amounts to about 10,000.

NOTES AND QUERIES.

Yeast.—The essential cause of the difference of beer-yeast and the so-called German yeast, is due—1st, to the materials submitted to fermentation; 2nd, to the mode of conducting that process. The so-called German yeast is chiefly made at Schiedam, and owes its origin and qualities to the large quantity of raw (that is to say, unmalted) grain, chiefly rye, used for making Hollands. More correctly speaking, the starch of the grain, after having been converted into sugar by the aid of a comparatively small quantity of barley-malt, is suffered to undergo alcoholic fermentation. This fermentation proceeds far more slowly than the fermentation of the wort of malt intended for beer; and it is the slowness of this process, the use of raw grain, and the peculiar mode of setting up the fermentation, which constitute the essential difference of the yeast. After it leaves the distilleries, the yeast is carefully washed with very cold and pure water, and often, though not always, mixed with some very finely-ground starch; and, next, strongly pressed into stout canvas bags, and sent off to Paris, Berlin, Vienna, and elsewhere. If beer-yeast were washed, it would, perhaps, keep a longer time, but never so long as the yeast just alluded to, owing to the fact that the formation of beer-yeast takes place more tumultuously. German yeast has been made perfectly dry over sulphuric acid *in vacuo*, and in that state it may be kept, in well-closed bottles or tin canisters, in a dry and cool place, for any length of time, and has been sent, in good condition, even to Batavia and Calcutta.

THE CHEMICAL NEWS.

Vol. XX. No. 509.

BRITISH ASSOCIATION
FOR THE
ADVANCEMENT OF SCIENCE.

Exeter Meeting, August 18, 1869.

INAUGURAL ADDRESS OF THE PRESIDENT,

George Gabriel Stokes, M.A., Sec. R.S.,
D.C.L., Oxon.; LL.D., Dublin;
Fellow of Pembroke College; and Lucasian Professor of Mathematics in the University of Cambridge.

(Concluded from p. 89).

Researches on Gun-Cotton.

As I have mentioned an application to the Government on the part of the Association which was not successful, it is but right to say that such is not generally the result: I will refer to one instance. At the Cambridge meeting of the Association, in 1862, a committee, consisting of representatives of the Mechanical and Chemical Sections, was appointed for the purpose of investigating the application of gun-cotton to warlike purposes. At the Newcastle meeting, in the following year, this committee presented their report. It was felt that a complete study of the subject demanded appliances which could be obtained only from our military resources; and at the Newcastle meeting a resolution was passed recommending the appointment of a royal commission. This recommendation was adopted, and, in 1864, a commission was appointed, which was requested to report on the application of gun-cotton to civil as well as to naval and military purposes. The committee gave in their report last year, and that report, together with a more recent return relative to the application of gun-cotton to mining and quarrying operations, has just been printed for the House of Commons.

A substance of such comparatively recent introduction cannot be fairly compared with an explosive in the use of which we have the experience of centuries. Yet, even with our present experience, there are some purposes for which gun-cotton can advantageously replace gunpowder, while its manufacture and storage can be effected with comparative safety, since it is in a wet state during the process of manufacture, and is not at all injured by being kept permanently in water, but merely requires to be dried for use. Even should it be required to store it in the dry state, it is doubtful whether, with the precautions indicated by the chemical investigations of Mr. Abel, any greater risk is incurred than in the case of gunpowder. In the blasting of hard rocks it is found to be highly efficient; while the remarkable results recently obtained by Mr. Abel leave no doubt of its value for explosions such as are frequently required in warfare. General Hay speaks highly of the promise of its value for small arms; but many more experiments are required, especially as a change in the arm and mode of ignition require a change in the construction of the cartridge. In heavy ordnance, the due control of the rapidity of combustion of the substance is a matter of greater difficulty; and, though considerable progress has been made, much remains to be done before the three conditions of safety to the gun, high velocity of projection, and uniformity of result, are satisfactorily combined.

Deep Sea Soundings.

By the kindness of Dr. Carpenter, I am enabled to mention to you the latest results obtained in an expedition which could not have been undertaken without the aid of Government—an aid which was freely given. Last year, Dr. Carpenter and Professor Wyville Thomson represented to the President and Council of the Royal Society the great importance to zoology and palæontology of obtaining soundings from great depths in the ocean, and suggested to them to use their influence with the Admiralty to induce them to place a gun-boat, or other suitable vessel, at the disposal of those gentlemen, and any other naturalists who might be willing to accompany them, for the purpose of carrying on a systematic course of deep-sea dredging for a month or six weeks. This application was forwarded to the Admiralty with the warm support of the President and Council, and was readily acceded to. The operations were a good deal impeded by rough weather, but, nevertheless, important results were obtained. Dredging was successfully accomplished at a depth of 650 fathoms; and the existence was established of a varied and abundant submarine fauna, at depths which had generally been supposed to be either azoic or occupied by animals of a very low type; and the character of the fauna and of the mud brought up was such as to point to a chalk formation actually going on.

It seemed desirable to carry the soundings to still greater depths, and to examine more fully the changes of temperature which had been met with in the descent. Another application was accordingly made to the Admiralty, in the present year, and was no less readily acceded to than the former; and a larger vessel than that used last year is now on her cruise. I am informed by Dr. Carpenter that dredging has been successfully carried down to more than 2400 fathoms (nearly the height of Mont Blanc), and that animal life has been found, even at that depth, in considerable *variety*, though its *amount* and *kind* are obviously influenced by the reduction of temperature to Arctic coldness. A very careful series of temperature soundings has been taken, showing, on the same spot, a continuous descent of temperature with the depth, at first more rapid, afterward pretty uniform. Thermometers protected from pressure by a plan described by Dr. Miller were found to maintain their character at the great depths reached, the difference between them and the best ordinary thermometers used in the same sounding being exactly conformable to the pressure corresponding with each depth, as determined by the experiments previously made in smaller depths. All the observations hitherto made go to confirm the idea of a general interchange of polar and equatorial water, the former occupying the lowest depths, the latter forming a superficial stratum of 700 or 800 fathoms. The analyses of the water brought up indicate a large proportion of carbonic acid in the gases of the deep waters, and a general diffusion of organic matter.

The Faraday Memorial.

I must turn, for a few moments, to another application recently made to Government, which has not been successful. The application I have in view was made, not by the British Association or other scientific societies in their corporate capacity, but by a body composed of the Presidents of the British Association, and of the Royal and other leading scientific societies; and its object was, not the promotion of science directly, but the recognition of pre-eminent scientific merit. In the history of science, few names, indeed, hold so prominent a place as that of Faraday. The perfect novelty of principle, and recondite nature of many of his great discoveries, are such as to bear the impress of genius of the highest order, and to form an epoch in the advance of science; and, while his scientific labours excited the admiration of men of science throughout the world, his singularly genial disposition, and modest, unassuming character, won for him the love of those who had the happiness of numbering him among their personal friends. At a meeting of the presidents of

the scientific societies to which I have alluded, it was resolved to erect a marble statue in memory of Faraday. He was a man of whom England may well be proud, and it was thought that it would be a graceful recognition of his merits if the monument were erected at the public expense. The present Chancellor of the Exchequer, however, did not think it right that the recognition of scientific merit, however eminent, should fall on the taxation of the country, though, even in a pecuniary point of view, the country has received so much benefit from the labours of scientific men. The carrying out of the resolution being thus left to private exertion, a public meeting, presided over by H.R.H. the Prince of Wales, was held in the Royal Institution, an establishment which has the honour of being identified with Faraday's scientific career. At this meeting a committee was formed to carry out the object, and a subscription list commenced. By permission of the secretaries of this association, an office has been opened in the Reception Room, where those members of the association who may be desirous of taking part in the movement will have every facility afforded them.

Recent Discoveries in Chemistry.

In chemistry, I do not believe that any great step has been made within the last year; but perhaps there is no science in which an earnest worker is so sure of being rewarded by making some substantial acquisition to our knowledge, though it may not be of the nature of one of those grand discoveries which from time to time stamp their impress on different branches of science. I may be permitted to refer to one or two discoveries which are exceedingly curious, and some of which may prove of considerable practical importance.

Turacine.

The turaco or plantain-eater of the Cape of Good Hope is celebrated for its beautiful plumage. A portion of the wings is of a fine red colour. This red colouring-matter has been investigated by Professor Church, who finds it to contain nearly six per cent of copper, which cannot be distinguished by the ordinary tests, nor removed from the colouring-matter without destroying it. The colouring-matter is, in fact, a natural organic compound, of which copper is one of the essential constituents. Traces of this metal had previously been found in animals—for example, in oysters, to the cost of those who partook of them. But, in these cases, the presence of the copper was merely accidental; thus oysters that lived near the mouths of streams which came down from copper mines assimilated a portion of the copper salt, without apparently its doing them either good or harm. But, in the turaco, the existence of the red colouring-matter which belongs to their normal plumage is dependent upon copper, which, obtained in minute quantities with the food, is stored up in this strange manner in the system of the animal. Thus, in the very same feather, partly red and partly black, copper was found in abundance in the red parts, but none, or only the merest trace, in the black.

This example warns us against taking too utilitarian a view of the plan of creation. Here we have a chemical substance elaborated which is perfectly unique in its nature, and contains a metal the salts of which are ordinarily regarded as poisonous to animals; and the sole purpose to which, so far as we know, it is subservient in the animal economy is one of pure decoration. Thus, a pair of fine birds which were kept in captivity lost their fine red colour in the course of a few days, in consequence of washing in the water which was left them to drink, the red colouring-matter, which is soluble in water, being thus washed out; but, except as to the loss of their beauty, it does not appear that the birds were the worse for it.

Artificial Alizarine.

A large part of the calicos which are produced in this country in such enormous quantities are sent out into the market in the printed form. Although other substances are employed, the place which madder occupies among dye-stuffs with the calico-printer is compared by Mr. Schunck to that which iron occupies among metals with the engineer. It appears, from the public returns, that upwards of 10,000 tons of madder are imported annually into the United Kingdom. The colours which madder yields to mordanted cloth are due to two substances, alizarine and purpurine, derived from the root. Of these, alizarine is deemed the most important, as producing faster colours and yielding finer violets. In studying the transformations of alizarine under the action of chemical reagents, MM. Græbe and Liebermann were led to connect it with anthracene, one of the coal-tar series of bodies, and to devise a mode of forming it artificially. The discovery is still too recent to allow us to judge of the cost with which it can be obtained by artificial formation, which must decide the question of its commercial employment. But, assuming it to be thus obtained at a sufficiently cheap rate, what a remarkable example does the discovery afford of the way in which the philosopher, quietly working in his laboratory, may obtain results which revolutionise the industry of nations! To the calico-printer, indeed, it may make no very important difference, whether he continues to use madder, or replaces it by the artificial substance; but what a sweeping change is made in the madder-growing interest! What hundreds of acres, hitherto employed in madder cultivation, are set free for the production of human food, or of some other substance useful to man! Such changes can hardly be made without temporary inconvenience to those who are interested in the branches of industry affected; but we must not, on that account, attempt to stay the progress of discovery, which is conducive to the general weal.

Apomorphia.

Another example of the way in which practical applications unexpectedly turn up when science is pursued for its own sake, is afforded by a result recently obtained by Dr. Matthiessen, in his investigation of the constitution of the opium bases. He found that, by the action of hydrochloric acid on morphia, a new base was produced, which, as to composition, differed from the former merely by the removal of one equivalent of water. But the physiological action of the new base was utterly different from that of the original one. While morphia is a powerful narcotic, the use of which is apt to be followed by subsequent depression, the new base was found to be free from narcotic properties, but to be a powerful emetic, the action of which was unattended by injurious after-effects. It seems likely to become a valuable remedial agent.

In relation to mechanism, this year is remarkable as being the centenary of the great invention of our countryman, James Watt. It was in the year 1769 that he took out his patent involving the invention of separate condensation, which is justly regarded as forming the birth of the steam-engine. Little could even his inventive mind have foreseen the magnitude of the gift he was conferring on mankind in general, and on his own country more particularly. In these days of steamers, power-looms, and railways, it requires no small effort to place ourselves, in imagination, in the condition we should be in without the steam-engine. It needs no formal celebration to remind Britons of what they owe to Watt. Of him, truly it may be said "*si monumentum requiras, circumspice.*"

The Relations between Physical and Biological Sciences.

With reference to those branches of science in which we are more or less concerned with the phenomena of life, my own studies give me no right to address you. I regret this the less because my predecessor, and my probable successor in the presidential chair are both of well-known eminence in this department. But I hope I may be permitted, as a physicist, and viewing the question from the physical side, to express to you my views as to the relation which the physical bear to the biological sciences.

No other physical science has been brought to such

perfection as mechanics; and in mechanics we have long been familiar with the idea of the perfect generality of its laws, of their applicability to bodies organic as well as inorganic, living as well as dead. Thus, in a railway collision, when a train is suddenly arrested, the passengers are thrown forward, by virtue of the inertia of their bodies, precisely according to the laws which regulate the motion of dead matter. So trite has the idea become, that the reference to it may seem childish; but, from mechanics, let us pass on to chemistry, and the case will be found by no means so clear. When chemists ceased to be content with the mere ultimate analysis of organic substances, and set themselves to study their proximate constituents, a great number of definite chemical compounds were obtained which could not be formed artificially. I do not know what may have been the usual opinion at that time among chemists as to their mode of formation. Probably it may have been imagined that chemical affinities were indeed concerned in their formation, but controlled and modified by an assumed vital force. But, as the science progressed, many of these organic substances were formed artificially, in some cases from other and perfectly distinct organic substances, in other cases actually from their elements. This statement must, indeed, be accepted with one qualification. It was stated several years ago, by M. Pasteur, and I believe the statement still remains true, that no substance, the solution of which possesses the property of rotating the plane of polarisation of polarised light, had been formed artificially from substances not possessing that property. Now several of the natural substances which are deemed to have been produced artificially are active, in the sense of rotating the plane of polarisation; and, therefore, in these cases, the inactive artificial substances cannot be absolutely identical with the natural ones. But the inactivity of the artificial substance is readily explained on the supposition that the artificial substance bears to the natural the same relation as racemic acid bears to tartaric—that it is, so to speak, a mixture of the natural substance with its image in a mirror. And when we remember by what a peculiar and troublesome process M. Pasteur succeeded in separating racemic acid into the right-handed and left-handed tartaric acids, it will be at once understood how easily the fact, if it be a fact, of the existence in, the natural substance, of a mixture of two substances, one right-handed and the other left-handed, but otherwise identical, may have escaped detection. This is a curious point, to the clearing up of which it is desirable that chemists should direct their attention. Waiving, then, the difference of activity or inactivity, which, as we have seen, admits of a simple physical explanation, though the correctness of that explanation remains to be investigated, we may say that, at the present time, a considerable number of what used to be regarded as essentially natural organic substances have been formed in the laboratory. That being the case, it seems most reasonable to suppose that, in the plant or animal from which those organic substances were obtained, they were formed by the play of ordinary chemical affinity, not necessarily nor probably by the same series of reactions by which they were formed in the laboratory, where a high temperature is commonly employed, but still by chemical reactions of some kind, under the agency, in many cases of light, an agency sometimes employed by the chemist in his laboratory. And, since the boundary line between the natural substances which have and those which have not been formed artificially, is one which, so far as we know, simply depends upon the amount of our knowledge, and is continually changing as new processes are discovered, we are led to extend the same reasoning to the various chemical substances of which organic structures are made up.

But do the laws of chemical affinity, to which, as I have endeavoured to infer, living beings, whether vegetable or animal, are in absolute subjection, together with those of capillary attraction, of diffusion, and so forth, account for the formation of an organic structure, as distinguished from the elaboration of the chemical substances of which it is composed? No more, it seems to me, than the laws of motion account for the union of oxygen and hydrogen to form water, though the ponderable matter so uniting is subject to the laws of motion during the act of union just as well as before and after. In the various processes of crystallisation, of precipitation, and so forth, which we witness in dead matter, I cannot see the faintest shadow of an approach to the formation of an organic structure, still less to the wonderful series of changes which are concerned in the growth and perpetuation of even the lowliest plant. Admitting, to the full, as highly probable, though not completely demonstrated, the applicability to living beings of the laws which have been ascertained with reference to dead matter, I feel constrained, at the same time, to admit the existence of a mysterious *something* lying beyond—a something, *sui generis*, which I regard, not as balancing and suspending the ordinary physical laws, but as working with them and through them to the attainment of a designed end.

What this *something*, which we call life, may be, is a profound mystery. We know not how many links in the chain of secondary causation may yet remain behind; we know not how few. It would be presumptuous, indeed, to assume, in any case, that we had already reached the last link, and to charge with irreverence a fellow worker who attempted to push his investigations yet one step further back. On the other hand, if a thick darkness enshrouds all beyond, we have no right to assume it to be impossible that we should have reached even the last link of the chain; a stage where further progress is unattainable, and we can only refer the highest law at which we stopped to the fiat of an Almighty Power. To assume the contrary as a matter of necessity, is, practically, to remove the First Cause of all to an infinite distance from us. The boundary, however, between what is clearly known and what is veiled in impenetrable darkness, is not ordinarily thus sharply defined. Between the two there lies a misty region, in which loom the ill-discerned forms of links of the chain which are yet beyond us. But the general principle is not effected thereby. Let us fearlessly trace the dependence of link on link as far as it may be given us to trace it; but let us take heed that, in thus studying second causes, we forget not the First Cause, nor shut our eyes to the wonderful proofs of design which, in the study of organised beings especially, meet us at every turn.

Truth we know must be self-consistent, nor can one truth contradict another, even though the two may have been arrived at by totally different processes—in the one case, suppose, obtained by sound scientific investigation, in the other case taken on trust from duly authenticated witnesses. Misinterpretations, of course, there may be on the one side or on the other, causing apparent contradictions. Every mathematician knows that in his private work he will occasionally, by two different trains of reasoning, arrive at discordant conclusions. He is at once aware that there must be a slip somewhere, and sets himself to detect and correct it. When conclusions rest on probable evidence, the reconciling of apparent contradictions is not so simple and certain. It requires the exercise of a calm, unbiassed judgment, capable of looking at both sides of the question; and oftentimes we have long to suspend our decision, and seek for further evidence. None need fear the effect of scientific enquiry carried on in an honest, truth-loving, humble spirit, which makes us no less ready frankly to avow our ignorance of what we cannot explain, than to accept conclusions based on sound evidence. The slow but sure path of induction is open to us. Let us frame hypotheses if we will: most useful are they when kept in their proper place, as stimulating inquiry. Let us seek to confront them with observation and experiment, thereby confirming or upsetting them, as the result may prove; but let us beware of placing them prematurely in the rank of ascertained truths, and building further conclusions on them, as if they were.

When, from the phenomena of life, we pass on to those of mind, we enter a region still more profoundly mysterious. We can readily imagine that we *may* here be dealing with phenomena altogether transcending those of mere life, in some such way as those of life transcend, as I have endeavoured to infer, those of chemistry and molecular attractions, or as the laws of chemical affinity, in their turn, transcend those of mere mechanics. Science can be expected to do but little to aid us here, since the instrument of research is itself the object of investigation. It can but enlighten us as to the depth of our ignorance, and lead us to look to a higher aid for that which most neatly concerns our well-being.

PRELIMINARY REPORT OF THE COMMITTEE APPOINTED FOR THE

DETERMINATION OF THE GASES EXISTING IN SOLUTION IN WELL WATERS.*

By DR. E. FRANKLAND, F.R.S., and HERBERT McLEOD, F.C.S.

In consequence of the investigation being far from complete, this report must be considered as merely a preliminary one; a more detailed account of the results obtained and the inferences to be drawn from them must be postponed till a future occasion.

The apparatus employed in these and other experiments was described at the last meeting of the Chemical Society, and will shortly be published in the *Journal*.†

In collecting the waters, it is, of course, of the greatest importance that they should be prevented from coming in contact with the air, otherwise, serious errors might be produced in the determination of the gases dissolved. In order to avoid these errors, the tap delivering the water from the pumps is connected, by means of a caoutchouc tube, with a tubulure at the bottom of a tin cylinder, about 10 inches high, and 7 in diameter. The water is turned on, and allowed to flow over the edge of the vessel; thus only the surface of the water is exposed to the action of the air, and the liquid at the lower part of the vessel is protected by the upward current and continual overflow.

The bottles used for collecting the waters hold a little more than 100 c.c., and a separate quantity is used for each experiment. Into each bottle a piece of glass tube bent in the form of a U is introduced; one end of the tube is sealed, and, in the closed limb, a bubble of air is confined by mercury, which fills the open limb and the bend. In the collection of each water, four of these bottles are lowered, by means of pieces of string, into the tin vessel while the water is flowing over its edge. After being filled, each bottle is carefully examined, and, if any bubbles of gas adhere to the sides, they must be removed. The bottles are then again lowered into the vessel, and the temperature observed. A syphon is now passed to the bottom of one of the bottles, and, after it has drawn two or three hundred cubic centimetres of water through the bottle, it is placed into the second. The first bottle is now raised, and, while its neck is still under the water, a slightly-greased stopper is put into the neck, and carefully pressed down. This force compresses the air contained in the glass tube, and, if the pressure is sufficient, it prevents the escape of gas from the water—a precaution which, in some cases, is very necessary. The syphon is then transferred from the second into the third bottle, and the second is closed and removed. When the four bottles have been filled, the stoppers are covered with ground caps. The caps are next filled with mercury, through small holes at their tops, which are afterwards closed with glass stoppers.

The gases should be removed from the waters as soon after collection as possible. In the following cases, the greatest length of time which was allowed to elapse between these operations was five days; but usually the removal of the gases was effected the day after the collection.

	I. Rain-water.	II. Water from cistern of Royal College of Chemistry, supplied by Grand Junction Company.	III. Water from well, in chalk, 367 ft. deep, at Messrs. Barclay and Perkins's Brewery, Southwark.	IV. Water from well not down to chalk, in course of construction, 143½ ft. deep, at Messrs. Barclay and Perkins's Brewery, Southwark.	V. Water from chalk well at Worthing.	VI. Water from surface well to face of the chalk, 27—30 ft. deep, at Mr. Hill's Brewery, Deal. In the town. Influenced by the tide.	VII. Water from chalk well 115 ft. deep, Waterworks, Deal, surrounded by cultivated fields. Not influenced by tide.	VIII. Water from Waterworks, Deal, drawn from main about a mile from the reservoir.
Temperature at time of collection (° C.) ..	15·5	14·8	12·1	12	(?)	11·9	14·8	17·2
Mean of..	2 expts.	2 expts.	2 expts.	4 expts.	2 expts.	2 expts.	2 expts.	2 expts.
Volumes of gases in 100 volumes of water. Nitrogen ..	1·382	1·397	2·030	1·973	1·552	1·704	1·548	2·241
Oxygen ..	0·673	0·620	0·029	0·018	0·446	0·023	0·580	0·796
Carbonic anhydride	0·135	4·239	5·765	3·814	5·452	10·252	5·055	4·413
Total ..	2·190	6·256	7·824	5·805	7·450	11·979	7·183	7·450
Solubility of nitrogen in 100 volumes of distilled water (Bunsen) ..	1·468 at 15·5°	1·478 at 15°	1·549 at 12°	1·549 at 12°	—	1·549 at 12°	1·478 at 15°	1·441 at 17°

The experimental results, of which the above numbers are the means, were tolerably concordant. The greatest differences between the results of different experiments are the following:—In water No. IV., experiment 3 gave 0·140 parts more nitrogen than experiment 2; in water No. VII., the oxygen obtained in the second experiment was 0·045 in excess of the quantity obtained in the first; in water No. III., the second experiment gave 0·760 parts more carbonic anhydride than the other. Since this last was done, the mode of collection and removal of the gases have been improved.

With so few results as have been obtained up to the present, it will be impossible to do more than point out the small quantity of oxygen in the waters from deep wells as compared with those from shallow ones, and with rain and river waters. The quantity of nitrogen is also very remarkable as being, in all the cases, except the river and rain waters, in excess of the amount absorbable by distilled water. To show this, there is introduced into the foregoing table numbers from Bunsen's gasometry, indicating the quantities of nitrogen absorbable by 100 volumes of

* Read before the British Association, Exeter meeting, Section B.

† See CHEMICAL NEWS, vol. xx., p. 20.

distilled water at the temperatures which are nearest to those at which the waters were collected. The reasons of this apparent anomaly will be investigated during the course of the ensuing year, and it is hoped that, by the next meeting of the Association, a much larger amount of information will have been obtained. The prosecution of the experiments has been much hindered by the necessity of perfecting the apparatus for the removal of the gases and the means of collection, so that it was not until after the commencement of July that any systematic work could be commenced.

REPORT ON THE CHEMICAL NATURE OF CAST-IRON.*

By Messrs. F. A. ABEL, F.R.S., D. FORBES, F.R.S., and A. MATTHIESSEN, F.R.S.

THE Committee have to report that, during the past year, some material progress has been made in this research. They entrusted the preparation of pure iron to Dr. Matthiessen, who carried out this part of the investigation in conjunction with M. Prus-Szczepanowski. From a series of experiments, which are detailed in the Appendix, pure iron appeared to be obtainable in considerable quantities; and we hope, if the Committee be re-appointed, that next year a great deal of valuable information will be obtained on the chemical nature and physical properties of pure iron and its alloys. The iron obtained by the process described in the Appendix is almost absolutely pure, containing only a minute trace of sulphur. According to an analysis made by Professor Abel, the iron contained, in 100 parts, only 0·00025 parts of sulphur. In another analysis, the amount of sulphur found by M. Prus-Szczepanowski amounted to 0·0007 per cent. Phosphorus and silicon were carefully tested for by both analysts, and found to be entirely absent. The amount of substance taken for each analysis was about 30 grammes.

APPENDIX.

ON THE PREPARATION OF PURE IRON.

By A. MATTHIESSEN, F.R.S., and S. PRUS-SZCZEPANOWSKI.

AFTER numerous trials, the general outline of which was given in the report of last year, the following method was found to yield nearly absolutely pure iron, in quantities sufficient for the purpose of this research. Pure dried ferrous sulphate, and pure dried sodium sulphate, are mixed in nearly equal proportions, and introduced gradually into a red-hot platinum crucible. The mass is kept in fusion until the evolution of sulphurous acid gas ceases. The crucible is then allowed to cool, and the fused mass extracted with water. If the heat be properly regulated, the whole of the iron is left as a very fine crystalline oxide. This oxide is thoroughly washed, by decantation, to remove every trace of the sodium sulphate, and, after being dried, is reduced, by hydrogen, in a platinum crucible; the spongy iron thus obtained is then pressed into solid buttons, and melted in lime crucibles with the oxyhydrogen blowpipe.

Before proceeding further, it will be as well to mention the precautions observed in obtaining the raw material in the purest state. The commercial pure ferrous sulphate was freed from every trace of copper by leading sulphuretted hydrogen through the warm acetic acid solution. After filtration, the ferrous sulphate was twice re-crystallised, and dried, first in a water-bath, then in an air-bath. The commercial crystallised sodium sulphate was re-crystallised several times, to get rid of the last trace of chloride of sodium, and then heated on a water-bath to melt the crystals. As is well-known, anhydrous sodium sulphate separates out from this solution, which was scooped out from time to time, dried on an air-bath, and powdered. The purification of the sodium sulphate from chloride of sodium was found to be necessary, owing to the fact that when fusions were made with sodium sulphate containing that salt, the resulting oxide of iron always contained platinum. The hydrogen used for the reduction of the iron, as well as for the blowpipe, was prepared by the action of sulphuric acid on zinc, and purified by leading the gas through two wash bottles—the first containing nitrate of silver and strong nitric acid, and the second caustic soda and acetate of lead—both bottles being half filled with pieces of pumice-stone. The oxygen was prepared by heating a mixture of chlorate of potassium with 15 to 20 per cent of black oxide of manganese, and washed by leading through caustic soda. All connections were made of glass, lead, or pure india-rubber tubing.

The fusion took place in a large platinum crucible (the contents of which are rather more than ½ a litre), enclosed in the usual manner in a clay crucible. The dimensions were such, therefore, that about a kilo. and a half of the mixture could be fused at each operation. After fusion, the crucible is allowed to cool; it is then boiled out with distilled water, and the accumulated product of 6 to 8 fusions washed by decantation with boiling distilled water. The crystalline oxide settles very quickly, and thus allows of a very rapid and thorough washing. The washing was in every case continued several times after the wash waters ceased to give any turbidity with barium nitrate. It is worthy of mention that the above process to prepare pure oxide from the mixture of mixed sulphates yields the purest oxide we as yet obtained. The reduction of the oxide thus formed was made in a covered platinum crucible, heated by means of a large Bunsen burner. The hydrogen was introduced by means of a platinum tube, reaching through the cover to the bottom of the crucible. The gas, purified as described above, and dried by chloride of calcium, was always kept slightly in excess, a constant stream of gas being obtained by not using the generator, but two large gas-holders joined together, the contents of each being about 600 litres (20 cubic feet); two other gas-holders of similar capacity being used for the storage of the oxygen, the one being used to collect the gas from the retort, the other to contain the gas purified by passing it through a strong solution of caustic soda.

The resulting spongy iron was pressed into solid buttons, by means of a strong coining press and a diamond mortar, the cylinder of which being about 70 m.m. in height, the iron, when pressed, forms a cylinder of about 15 m.m. in height, and weighs about 20 grammes. The melting of the compressed iron took place in lime crucibles, the lime having been previously burnt, slacked, and re-burnt, thus forming a fine, impalpable powder, which was compressed in the crucible mould.

The best method of fusion was found to be as follows:—The lime crucible was placed in a slanting position on a piece of lime. One of the oxyhydrogen blowpipes used in the process played on the outside of the crucible whilst the flame of the other was directed inside. When white-hot, a cylinder of the compressed iron was thrown into it. It quickly melts, but at the expense of a large quantity of the iron which is oxidised. The amount lost by the oxidation varies between 25 to 50 per cent. In order to obtain a good solid button of melted iron, it is necessary to cool it in an atmosphere of hydrogen, which is easily obtained simply by turning off the oxygen from the blowpipe playing inside the crucible. The button thus obtained weighs about 15 grammes. On analysis, it was found that the buttons were free from sulphur, phosphorus, silicon, and calcium.

The preparation on a large scale of the pure ferrous sulphate and sodium sulphate was kindly undertaken for

* Read before the British Association, Exeter Meeting, Section B.

only 81·98 p.c. of metallic zinc. A specimen of what is sold as pure powdered zinc gave hydrogen corresponding to only 69·22 per cent of zinc.

With nickel and cobalt, the same process is applicable, and has been used for determining their atomic weights. The results have been communicated to the Chemical Society, and will be published in the *Journal* of the Society.*

The following results have been obtained with different specimens of iron:—

Dr. Matthiessen gave me what he believed to be a specimen of pure iron; it gave—

1st expt., 3·571 p.c. H, corresponds to 100·00 p.c. iron.
2nd „ 3·568 „ „ 99·93 „

Steel piano-wire (No. 10) gave—

1st expt., 3·444 p.c. H, corresponds to 96·45 p.c. iron.
2nd „ 3·445 „ „ 96·49 „

Some of the same wire was dissolved, and the amount of iron estimated by Penny's process.

1st. expt. gave 97·8 p.c. iron.
2nd „ 98·2 „

Mean.

Hydrogen process, 96·47. Penny's process, 98·00

This gives a suppression of hydrogen corresponding to 1·53 per cent of iron.

Cast-iron filings gave—

1st expt., 3·375 p.c. H, corresponds to 94·50 p.c. iron.
2nd „ 3·366 „ „ 94·27 „

When tested by Penny's process, the filings were found to contain 97·0 per cent of iron; this gives a suppression of hydrogen corresponding to 2·62 per cent of iron.

A specimen of grey crystalline pig-iron gave, when dissolved, a volume of hydrogen corresponding to only 89·04 per cent of iron.

A piece of magnesium ribbon evolved an amount of hydrogen corresponding to 99·18 per cent of metal.

The foregoing results will serve simply to indicate the kind of results which have been obtained by this form of volumetric analysis.

ON JARGONIA.†

By H. C. SORBY, F.R.S.

I HEREWITH send, for exhibition at the Chemical Section, what I believe to be nearly pure zirconia, and jargonia prepared by a modified combination of the methods described by Mr. David Forbes and myself. You will notice, at once, that the zirconia is perfectly white, whereas the jargonia is of a clear straw-colour. This exactly corresponds with the difference between the opaque borax blowpipe-beads heated to redness, as described in my paper in the *Proceedings of the Royal Society*, and I am strongly inclined to believe that it is a characteristic peculiarity. At first, I thought it might be due to the presence of a small quantity of iron, since zirconia, containing a little of the peroxide, is of a similar yellow colour. When, however, that is digested in sulphide of ammonium, it quickly turns to a deep green colour; whereas this yellow jargonia does not turn at all green. Subsequent experiments may show that the colour is due to some other substance; but, taking all the facts now known into consideration, it seems extremely probable that, after ignition, jargonia is of a clear straw-colour, paler than that of tungstic acid, but deeper than that of ceroso-ceric oxide.

* See CHEMICAL NEWS, vol. xx., p. 20.

† Extract from a letter to Mr. Crookes, read before the Chemical Section of the British Association, Exeter meeting.

MISCELLANEOUS.

British Association for the Advancement of Science.—The following is a complete list of the papers which were brought before Section B (Chemical Science) at the Exeter Meeting:—

Herbert McLeod.—*Report on the Determination of the Gases Existing in Solution in Well Waters.*
A. Matthiessen.—*Report of the Committee on the Chemical Nature of Cast-Iron.*
M. Jacobi.—*On Electrolytic Iron.*
J. Moffat.—*On the Phosphorescence of the Sea and Ozone in Connection with Atmospheric Conditions.*
J. Moffat.—*On the Oxidation of Phosphorus and the quantity of Phosphoric Acid Excreted by the Kidneys in Connection with Atmospheric Conditions.*
C. Tomlinson.—*On a Remarkable Structural Appearance in Phosphorus.*
B. H. Paul.—*Report on Treatment and Utilisation of Sewage.*
F. Braby.—*On Extraction of Ammonia from Gas Liquor.*
Stevenson Macadam.—*On the Economic Distillation of Gas from Cannel Coal.*
Walter Weldon.—*On the Manufacture of Chlorine by means of Perpetually Regenerated Manganite of Calcium.*
T. L. Phipson.—*On some New Substances Extracted from the Walnut.*
T. L. Phipson.—*On the Solubility of Lead and Copper in Pure and Impure Water.*
W. J. Russell.—*On the Measurement of Gases as a Branch of Volumetric Analysis.*
C. Tomlinson.—*On the supposed Action of Light on Combustion.*
Crace Calvert.—*On the Amount of Soluble and Insoluble Phosphates in Wheat Seed.*
H. Sorby.—*On Jargonia.*
S. Williams.—*On the Action of Phosphoric-chloride on Hydric-Sulphate.*
J. Dewar and G. Cranston.—*On Some Reactions of Chloro-Sulphuric Acid.*
A. Matthiessen and C. R. A. Wright.—*On the Action of Hydrochloric Acid on Morphia and Codeia.*
T. Andrews.—*On the Absorption Bands of Bile.*
M. Janssen.—*Methode Spectrale pour la recherche des Composés du Sodium.*
M. Janssen.—*Sur le Spectre de la Vapeur d'Eau.*
W. C. Roberts.—*On a specimen of Obsidian from Java.*
W. D. Michell.—*Are Flint Instruments of the First Stone Age Found in the Drift?*
E. C. C. Stanford.—*A Chemical Method of Treating the Excreta of Towns.*
H. Bamber.—*On the Water Supplies to Plymouth, Devonport, and Exeter.*
P. Spence.—*On the Production of Higher Temperatures by Steam of 212° Fahrenheit.*
A. Oppenheim.—*On Bromo-iodide of Mercury.*
A. Oppenheim.—*On Benzoe-sulphuric Acid.*
Professor Jellett.—*On a Method of Determining with Accuracy the Ratio of the Rotating Powers of Cane Sugar and Inverted Sugar.*
Dr. Fritsche.—*Notes on Structural Change in Block Tin.*—Communicated by W. C. Roberts.
H. Cooke.—*On the Registration of Atmospheric Ozone in the Bombay Presidency, and the Chief Causes which Influence its Appreciable Amount in the Atmosphere.*
J. Lowthian Bell.—*On the Decomposition of Carbonic Oxide by Spongy Iron.*

Report of the Committee for Recommending Increased Facilities for Scientific Investigations.—The following is the report of the "Committee for Recommending Increased Facilities for Scientific Investigations:"—Your committee, having sought the council of many of the most eminent men of science of the United King-

dom upon these questions, so far as it was found practicable to do so, and having carefully deliberated thereon, have arrived at the following conclusions:—I. That the provision now existing in the United Kingdom of Great Britain and Ireland is far from sufficient for the vigorous prosecution of physical research. II. It is universally admitted that scientific investigation is productive of enormous advantages to the community at large; but these advantages cannot be duly reaped without largely extending and systematising physical research. Though of opinion that greatly increased facilities are undoubtedly required, your committee do not consider it expedient that they should attempt to define categorically how these facilities should be provided for the following reason:—Any scheme of scientific extension should be based on a full and accurate knowledge of the amount of aid now given to science, of the sources from which that aid is derived, and of the functions performed by individuals and institutions receiving such aid. Your committee have found it impossible, with the means and powers at their command, to acquire this knowledge. A formal inquiry, including the inspection of records to which your committee have not access, and the examination of witnesses whom they are not empowered to summon, alone can elicit the information that is required, and, as the whole question of the relation of the state to science, at present in a very unsettled and unsatisfactory position, is involved, they urge that a royal commission alone is competent to deal with the subject. Your committee hold that this inquiry is of a character sufficiently important to the nation, and sufficiently wide in its scope, to demand the use of the most ample and most powerful machinery that can be brought to bear upon it. Your committee therefore submit, as the substance of their report, the recommendation that the full influence of the British Association for the Advancement of Science should at once be exerted to obtain the appointment of a royal commission, to consider—(1). The character and value of existing institutions and facilities for scientific investigation, and the amount of time and money devoted to such purposes. (2). What modifications or augmentations of the means and facilities that are at present available for the maintenance and extension of science are requisite; and (3). In what manner these can be best supplied.

Place of Meeting for Next Year.—At the meeting of the General Committee, on Monday last, it was decided that the meeting next year should be held in Liverpool, under the presidency of Professor Huxley, F.R.S., &c.

Death of M. Leiber.—We regret to learn the sudden demise of M. Leiber, the founder of the *Moniteur de la Photographie*, and the *Encyclopédie Photographique*, one of the kindest and most intelligent of the scientific publishers of Paris. His establishment, the Librairie Centrale des Sciences, in the Rue de Seine, has, for the last fifteen or twenty years, been the daily resort of the most eminent men of science; and his extensive knowledge of the older chemical and physical opuscules (memoirs, papers, notes, reprints, &c.) published in France, Germany, England, and America, caused him to be frequently consulted by literary men and authors of scientific works. His loss will be keenly felt by a very large portion of the enlightened Parisian public. Among the foreign works issued by him in French, we may notice the excellent little treatise on "Electricity," by Sir William Snow Harris, and De Filippi's charming "Letters to my Daughter on Terrestrial Creation."

Molybdenum and Chromium.—These metals can, according to Loughlin, be easily prepared as follows:—A mixture of one part of pure molybdic acid and one and a half of cyanide of potassium is placed in a porcelain crucible, and the lid luted on; this is placed in a large crucible, and the interstices having been packed with animal charcoal, the entire arrangement is exposed to a strong white heat for twelve hours; when cold the inner crucible is found lined with a white silver-like metal not acted upon by hydrochloric acid, but readily dissolved by nitric acid, and having a specific gravity of 8·56. By substituting oxide of chromium for molybdic acid metallic chromium is obtained.—*Engineer.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, vol. lxix., No. 6, August 9, 1869.

This number contains the following papers and communications:—

Evaporation of Water by Plants.—M. Dehérain.—The author states—(1) the evaporation of water from the leaves of plants is a function entirely different from the evaporation of the same fluid from a not living (inert) surface, since the evaporation from leaves of plants is not interrupted by the state of saturation of the atmosphere; (2) this evaporation is especially due to the action of light; (3) those rays of light which are most effectual in aiding the decomposition of carbonic acid by the leaves are also those which chiefly assist the evaporation of water therefrom.

Non-Poisonousness of Coralline.—M. Guyot.—This paper contains the results of an exhaustive series of experiments by which it is fully proved that coralline, neither when taken internally even in large doses nor also when brought directly into the blood, is a poison, and that its use in dyeing is not dangerous, provided, at the same time, poisonous substances are avoided.

Some Phenomena of Decomposition Produced by Sunlight.—M. Morren.—The author, while repeating some of Professor Tyndall's experiments, but applying, instead of electric light, the bright sunlight of Marseilles's clear sky, has discovered that several inorganic substances are decomposed when a ray of sunlight is made to pass through them; among these sulphurous acid gas is enumerated, this gas being decomposed into oxygen and vapour of sulphur. This phenomenon is caused, according to the author, by a peculiar dissociation called into play by the vibratory motion of the light, which has the effect of breaking up the chemical combination; by means of spectrum analysis the author has discovered that the activity of the light in this aspect depends partly upon its colour, and partly upon the refringence and the nature of the decomposed substance. The author has also found that a thin layer of sulphate of quinine of no more than 4 or 5 m.m. thickness entirely arrests the chemical rays, as if it were a thick yellow-coloured piece of glass. The author states that the chemical effects of highly-heated platinum—for instance, the decomposition of water by that metal, are due to the accumulation of more and more refringent rays.

On the Laws which Rule the Part any Substance Plays between Two Solvents.—M. Berthelot.—This paper is, on account of the abstruseness of the subject treated of, and also because of the algebraic mode of treatment, not very well suited for abstraction with due justice to the author and the subject.

Heat Developed by the Combustion of Coal.—MM. Scheurer-Kestner and Meunier.—This paper is a continuation of a former paper on the same subject by the same authors. The coals treated are those from the Creuzot and some Belgium coals; as an instance of the composition in 100 parts of the former we quote the analysis of a sample designated anthracitic by the authors:—Water, 1·76; carbon, 87·36; hydrogen, 3·47: ash, 3·63; oxygen and nitrogen, 3·75, Belgian coal from Denain, in 100 parts—water, 1·14; carbon, 77·68; hydrogen, 4·10; oxygen and nitrogen, 10·73; ash, 6·35. The observed quantity of heat of combustion of the first-mentioned sample amounts to 9409 units; that of the last mentioned sample amounts to 9085 units.

Succinate, Benzoate, Nitrite, and Nitrate of Isopropyl.—M. R. Silva.—The succinate of isopropyl is a liquid exhibiting an agreeable but very peculiar smell; insoluble in water, soluble in alcohol and ether, inflammable at a higher temperature, boils at 228°, its specific gravity at 0° is 1·009 and at 18° 0·997. Benzoate of isopropyl is also a liquid exhibiting a very pleasant smell; insoluble in water, but soluble in alcohol and ether; boils at 218°, its specific gravity at 0° is 1·054, at 25° 1·013. Nitrite of isopropyl is an inflammable, slightly yellow-coloured, liquid, boiling at 45°; specific gravity at 0° 0·856, and at 25° 0·844. Nitrate of isopropyl is a colourless, very inflammable liquid, boiling between 101° and 102°; specific gravity at 0° 1·054, at 19° 1·036; its vapour detonates violently when strongly heated.

Transport of Artificially-Made Ice.—M. Toselli states that a solid block of ice weighing 23 kiloe., and made in 18 minutes by a process invented by him, has been sent from Paris to Algeria, and received there without more than a very trifling loss by melting during this long journey in hot summer weather.

A large number of papers and communications in this number again refer to the Newton-Pascal and Chasles Leverrier controversy.

of a rather complicated process from parachloronitrotoluol, exhibits an oily strongly refractive liquid, the odour of which is akin to that of toluidine; its specific gravity at 18° is 1·175; boils at 236°; combines readily with hydrochloric, sulphuric, and nitric acids, forming therewith solid crystalline compounds. The authors states that this communication is only preliminary, and that their researches on this subject are not yet quite finished.

On Bismuth Silver.—M. Kayser.—When molten bismuth begins to solidify, the well-known phenomenon of the expulsion of a portion of the yet fluid metal from the interior of the partly fluid mass is observed in consequence of the fact that the solidified metal is specifically lighter than the molten and fluid metal; admixture of other metals, while impeding the crystallisation of the bismuth, also impede its expansion on cooling, but all metals do not act in this respect alike, for the addition of about 10 per cent of lead to bismuth entirely prevents its expansion. An alloy of silver and bismuth behaves in a different manner. The author, while working with silver on the large scale, accidentally obtained an alloy of the former metal and bismuth consisting, in 100 parts, of Bi, 56·1; Ag, 43·5. Upon the surface of this alloy were observed a large number of spherical particles of bismuth, measuring from 5 to 10 millimetres diameter, and consisting, in 100 parts, of Bi, 97·6; Ag, 2·355. While the operation of cupellation was being continued and the quantity of silver rose to 60, 70, and 80 per cent, the globules of bismuth expelled contained invariably 2·5 per cent of silver.

On Crystallised Phosphoric Acid.—M. Krämer.—When an aqueous solution of phosphoric acid, the specific gravity of which has been ascertained, and which solution consequently contains a known quantity of water, is so concentrated by evaporation that the remaining acid exactly corresponds to the formula H_3PO_4, this solution, on cooling, solidifies, yielding beautifully prismatic crystals of pure phosphoric acid.

On the Stilben Series.—MM. Limpricht and Schwaner state that the insinuation made against their researches on this subject, and especially the statement made by M. Grimaux, that his communication, on this subject made in 1867 in the *Bulletin de la Société Chimique de Paris*, has been made improper use of by the authors of the paper on the above subject, recently published in this German periodical, is altogether erroneous; they vindicate their rights and priority in this notice.

A Base Homologous with Kyanæthin.—M. Bayer.—In a rather lengthy paper, the author states that he has discovered a substance which he calls kyanmethin, consisting, in 100 parts, of—Carbon, 58·50; hydrogen, 7·35; nitrogen, 34·15; formula, $C_6H_9N_3$. This substance is a crystalline solid, readily soluble in water, less readily so in alcohol and ether, fuses at about 180°, sublimes without being decomposed, forming thereby finely white-coloured needle-shaped crystals; its vapour is very irritating and excites coughing; its taste is bitter and very like that of quinine. This base combines with acids, forming readily crystallisable salts. This base is a product, among others, of the action of sodium upon aceto-nitrile. The hydrochlorate of this base is composed according to the formula $C_6H_9N_3HCl$.

Cosmos, August 7, 1869.

This number contains, among a great mass of useful information not suitable for abstraction in our columns, a paper on the—

Ripening of Grapes by Cutting away part of the Leaves.—M. J. Comté.—At a meeting of the Agricultural Society of Agen, the author called attention to a chemico-physiological fact of great importance. It appears to have been an old custom, and is yet so, to pull off from the vines, especially in the Southern parts of France, a large quantity of leaves, especially close to where the fruit is placed on the stems, so as to allow full sunlight to fall on the grapes, which, in consequence thereof, soon get an amber-yellow colour, and appear to be rather over-ripe. The author condemns this custom; and, while citing, among the older authorities on this subject, MM. Rosier and Chaptal, he states that, as regards the grapes, the presence of the leaves, as arranged by nature, is absolutely necessary to them for perfecting their maturity, which means for converting into grape sugar a portion of the acids present in the unripe grapes in large quantity. The carbonisation (by which word the author understands the addition of carbon to the acids) is effected by the leaves, through which the vegetable juice passes, for the purpose of becoming deoxidised. Fully ripe grapes should exhibit an agreeable green colour; grapes taken from the vine before they were ripe do not reach maturity at all, as other fruit does, but remain as they were. Taking away the leaves, therefore, does not ripen, or speed the ripening of the fruit, but only alters its colour to a shade of yellow, which genuinely ripe grown grapes never present. The taste of these yellow grapes is intensely sour, while that of the green-coloured ripe grapes is extremely sweet. The author regrets that the foolish practice alluded to is not authoritatively prohibited, on sanitary grounds, and for the reason that it is very injurious to the fruit-bearing of vineyards.

Levels of Two Seas.—M. Faye.—As a proof of the correctness of the geodesical survey made in 1798, during the celebrated Egyptian campaign, it may be stated that the author, on re-calculating the results then obtained for the difference in level between the Mediterranean and Red Seas, and comparing the results with those obtained when a survey for the construction of the Suez Canal was made in our time, found the results to be—0·85 metre for 1798, and 0·86 metre for 1866.

Influence of the Intensity of Coloured Light on the Quantity of Gas Set Free by Plants.—M. Prilleux.—It is well known that, under the influence of direct sunlight, the green-coloured parts of plants decompose carbonic acid. The author, in order to learn the effect of rays of light of equal intensity, has applied coloured solutions which could be rendered more or less deep-coloured by adding thereto dye-stuffs, while the intensity of the light was photometrically measured. In the midst of these coloured aqueous solutions, branches of aquatic plants were placed in large glasses filled with water saturated with carbonic acid. The undermentioned figures denote the activity of decomposition of carbonic acid for two kinds of aquatic plants thus exposed during one minute of time. No 1. refers to the *Potamogeton perfoliatus*, Nos. 2 and 3 to *Elodea canadensis*.

White light	64·75 ..	74·5 ..	51·36
Blue light	56·00 ..	58·8 ..	52·92
Orange light	55·30 ..	57·0 ..	38·00

There may, therefore, be deduced from these experiments that the differently coloured lights do also act differently upon the green parts of plants, and call forth an equal disengagement of oxygen, when the intensity of the light remains the same, and, consequently, all the rays of the solar spectrum cause the decomposition of carbonic acid by plants.

August 14, 1869.

For those interested in very speculative matters, we mention that this number contains, as did a preceding, and as will, in all probability, one or more of the next numbers, an article on the—

Means of Communication between our Earth and the Planets.—M. C. Cros.—We do not enter into the details, as they do not belong to the domain of chemistry or the sciences more immediately connected therewith.

Les Mondes, August 5, 1869.

We quote from this paper the following:—

Chemical Laboratory at Neufchâtel.—This well-known, beautifully-situated little Swiss town, with a population of about 11,000, has obtained an excellently well-arranged chemical laboratory, placed under the direction of Dr. Sacc. There is ample room provided for forty students to work comfortably, and provided with all useful instruments. The building contains lecture-rooms, and every other requisite. The town possesses excellent educational establishments, and is a very healthy place.

Manufacture of Various Objects from Quills.—M. Clerget.—While the southern parts of France, only a few hundred miles distant by rail from Paris, could throw into the trade large quantities of excellent material (home produced), the cost of transport by rail from Toulouse to Paris, for the same weight and bulk, is only two francs less than the enormously long and circuitous journey from Kasan and Nijni-Novgorod to Paris. The article in question, not being one subject to deterioration, requires, of course, no great speed in conveyance. The quills and feathers are sorted; the smallest are used for ornamenting toys, while the better quills are turned into tooth-picks, and nibs for writing purposes, and almost all the rest, except the pith, is used in ornamental-flower making, brush-making, and imitation of horse-hair work. The feathers have recently been woven into a tissue fit for use as carpets, by means of machinery invented by M. Bardin, the owner of the works inspected by the above-named gentleman officially, to see that all hygienic measures are duly carried out.

Researches on the Illumination of Liquids by means of a Beam of Neutral or Polarised Light.—M. Lallemand.—The author describes minutely in this paper a series of minute optical experiments with liquids suitably held in tubes. When a beam of sunlight is made to illuminate different liquids, there are observed various phenomena dependent upon the substance employed, or under observation. In this aspect, liquids are divided into three categories—(1) some do not possess any perceptible fluorescence, and are devoid of rotatory power; (2) they possess more or less fluorescence, and, akin to the first, are devoid of all rotatory power; (3) these fluids have rotatory power, and exhibit, in addition thereto, often a very strong fluorescence. To the first class belong, among other liquids, water, nitric and hydrochloric acids, and liquid ammonia. Samples of second class—Solutions in pure water of salts of quinine, also esculine, and, among pure liquids, perfectly chemically-pure sulphide of carbon. Third class—A concentrated solution of pure cane-sugar may serve as examples.

NOTES AND QUERIES.

Wood Lice.—Oil of turpentine, or, better yet, carbolic acid, especially if care be taken that the latter be pure and colourless, will destroy these insects, without injury to wood-work or furniture, which should be painted over, as it were, with these fluids. If, however, the smell of these substances be objected to, a solution of corrosive sublimate in water, with the addition of some common salt to increase its solubilty, may be applied; but this solution is highly poisonous to men and animals.

Estimation of Phosphates in Manures.—A very valuable communication appeared in the CHEMICAL NEWS (vol. xx., p. 77) on the "Estimation of Phosphates in Manures." Will Mr. Sutton, or any of your other correspondents, inform me if it is possible for a superphosphate to go back or lose any portion of its soluble phosphate and at the same time contain an excess of sulphuric acid? which I believe all commercial superphosphates do in a certain degree.—FARMER.

THE CHEMICAL NEWS.

Vol. XX. No. 510.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Professor Stokes has spoken wisely in defining the object and aim of the British Association as the "giving a more systematic direction to scientific inquiry." Without doubt, this is the paramount design. It is true that the Association serves as a vehicle for the bringing together of scientific men from various parts of England and the Continent, and thereby promotes a fellowship and a good feeling which workers in the same field should ever possess, and which no paper-war should ever disturb; it is true that it often imports pure science into most unscientific regions, and makes, for the time being, the city honoured by its presence, the focus *par excellence* of scientific thought and activity; and in its train there follows a host of fervid devotees who cry aloud to the inhabitants of the honoured city, "What time ye hear the sound of the cornet, sackbut, psaltery, and all kind of music, ye are to fall down and worship the golden image which we have set up," and the people *do* fall down and worship; and papers are read, and lectures delivered, and *soirées* given, and excursions made, and Mayors exercise the most unbounded hospitality, and the people shout "Hail" till they are hoarse, and the Local Committee works like a galley slave, and all for the glory, and honour, and welfare of science. These things help to make up a great whole, but the real and principal *work* of the Association is the "giving a more systematic direction to scientific inquiry," and the granting of sums of money for well indicated and defined purposes of research. It is by this means that the Association really influences the scientific world; it is by this means that it is leaving its impress upon the scientific progress of the age—an impress which will remain clear and distinct when all lesser matters shall have faded away, the men, the times, the very cities which received them, the very countries which gave them birth, each and all more evanescent than "*scientia immutabilis*;" each and all more destructible than facts "*travaillés jusqu'ii indestructibilité*." Francis Bacon has well compared the modes of research to the three ways of walking in the dark, for a man may either grope about as best he can, or he may be led by the hand of another, or he may direct his steps by a lantern, the last applying to the trying of experiments in definite order, with a determinate design, and in accordance with recognised laws of thoughts, and surely the Association both holds a lantern and leads by the hand when it gives "a more systematic direction to scientific inquiry."

There is no denying the fact that the year which has passed has not been brilliant in scientific results; yet it has been a year for much steady work. It is notable rather as a time for collecting particulars than as a time for the formation of generalisations. It is not that Nature has piped unto us and we have not danced,—it is not that we have ceased to torment phenomena by every known process which can lead to the revealing of secrets, but rather because there can never be a succession of great and notable discoveries or developments either in philosophy, or art, or science; an uniform progression either for good or for evil is an impossibility, and we must neither desire nor expect it. We may well rest content with our extended knowledge of the constitution of the sun as the dominant scientific result of the year which has intervened since the meeting of the British Association was held in Norwich.

ON THE MANUFACTURE OF CHLORINE BY MEANS OF PERPETUALLY-REGENERATED MANGANITE OF CALCIUM.*

By WALTER WELDON, F.C.S.

Since the last meeting of the British Association, chlorine has begun to be manufactured extensively by a process which depends on the production and perpetual regeneration of a compound no mention of which, so far as I can find, as yet exists in chemical literature. As this process, besides thus producing and continually re-producing what I believe to be a new compound, reduces, by fully 80 per cent, the principal item in the cost of the manufacture of chlorine, greatly increases the quantity of chlorine which can be practically obtained from a given quantity of hydrochloric acid, and, moreover, enables the manufacture of chlorine to be carried on without the production of any offensive residue, I have ventured to think that a very brief account of it might not be without interest to this Section.

What has hitherto been the ordinary process of manufacturing chlorine consists simply in digesting with hydrochloric acid ores containing peroxide of manganese. The reaction which takes place, besides liberating chlorine, produces chloride of manganese, which remains behind in solution after the chlorine has gone off, and has hitherto been usually thrown away. There have been proposed and tried a great number of processes for transforming this chloride into peroxide for use over again; but the only one of them which has met with the slightest measure of practical success, prior to that which is the subject of this paper, is the one which is known, from the name of its inventor, as Dunlop's process. Dunlop's process decomposes the chloride of manganese by heating its solution, under a pressure of from two to four atmospheres, with milk of carbonate of lime, and then, in the dry way, transforms the resulting carbonate of manganese into a mixture or compound of two equivalents of peroxide with one equivalent of protoxide, by subjecting it for forty-eight hours to the action of air at a temperature of about 600° Fahr. The product of Dunlop's process is a sufficiently satisfactory one, containing about 72 per cent of MnO_2; but the process requires a very formidable amount of apparatus, and, in this and other ways, is so costly that its use has never been extended beyond a single firm of manufacturers.

Three years ago, I began to endeavour to work out the idea of decomposing, by either lime or magnesia, the chloride of manganese in the residual liquors of the chlorine manufacture, and then blowing air through the resulting mixture of hydrated protoxide of manganese with solution of chloride of calcium, or of chloride of magnesium, as the case might be. I took for granted that one-half of the protoxide of manganese so treated was the largest proportion of it that could thereby be converted into MnO_2—in other words, that one could obtain only sesquioxide by this method; but it was soon found that,

* Read before the British Association, Exeter meeting, Section B.

when using lime to decompose the chloride of manganese, considerably more than half the protoxide operated upon was frequently converted into MnO_2. It was found, eventually, that more than half the protoxide was thus peroxidised only when more lime was used than simply the quantity necessary to decompose the chloride of manganese, and when what was treated with air was thus a mixture of protoxide of manganese and lime; and it was also found that in all such cases there was a definite relation between the quantity of lime associated with the protoxide of manganese and the quantity of the protoxide, in excess of half, which became peroxidised. This led to the discovery that, whereas when protoxide of manganese by itself is treated with air in the wet way, one-half is the maximum proportion of it which can thereby be converted into MnO_2, the association of a certain proportion of lime with the protoxide so treated will enable the whole of it to become converted into MnO_2. It is to this fact, together with that of the much greater rapidity with which protoxide of manganese can be peroxidised by treatment with air in the wet way when lime is present than when lime is not present, that the practical success of the new method of manufacturing chlorine is mainly due.

The action of lime in increasing the proportion of protoxide of manganese which can be peroxidised by treatment with air in the wet way evidently consists in the lime substituting itself for that part of the protoxide which, when protoxide of manganese not having any other basic substance associated with it is treated with air in the wet way, does not undergo peroxidation. It would seem that the production of MnO_2 in the wet way by direct combination between hydrated MnO and atmospheric oxygen absolutely requires the presence of a base with which the MnO_2 can combine as it forms. When protoxide of manganese not having any other basic substance associated with it is treated with air in the wet way, a part of the protoxide itself has to act as the required base; and this is the reason why, in that case, not more than half of the protoxide can become peroxidised, the other half being required to combine as MnO with the half which becomes converted into MnO_2. When, however, the protoxide of manganese which is treated with air in the wet way has lime associated with it, the MnO_2 which forms (or part of it, according to the proportion of lime present) combines with CaO instead of with MnO, thus leaving free to undergo peroxidation that part of the MnO which, but for the presence of the CaO, this MnO_2 must have combined with, and which would thus have got locked up in a state in which it would have been incapable of being peroxidised, at least in the wet way and by air alone. Hence, the presence of enough lime to take the place of that half of the protoxide which, if no lime were present, would have to go into combination as base, and also to supply enough base for that half itself to combine with after undergoing peroxidation, will enable the whole of the MnO operated upon to be raised to the state of MnO_2. The minimum quantity of lime which is enough for this purpose is an equivalent for each equivalent of MnO operated upon, or the quantity necessary to supply an equivalent of lime to all the MnO_2 which can be produced by the peroxidation of all the MnO.

By treating with air, then, a mixture of protoxide of manganese and lime suspended either in water or in solution of chloride of calcium, there is formed a compound containing MnO_2 and CaO, in the proportion of an equivalent of one to an equivalent of the other. This compound may be regarded as sesquioxide of manganese, or Mn_2O_3, the MnO in which is replaced by CaO. I call it manganite of calcium, and I believe it to be a new compound. Gorgrew, in 1862, described a compound which he called manganite of calcium; but his compound contained five equivalents of MnO_2 per equivalent of CaO, and the CaO in it was so feebly combined that it readily decomposed chloride of manganese. My compound contains only one equivalent of MnO_2 per equivalent of CaO, and has no action upon salts of manganese.

This compound has now been produced and re-produced to the extent of some hundreds of tons. The process of producing it and applying it to the manufacture of chlorine is conducted as follows:—The residual liquor which remains after a charge of manganite has reacted upon hydrochloric acid in any suitable still is run from the still into a well or other receptacle, in which it is treated with carbonate of lime, to neutralise any free acid, and to decompose any sesquichloride of iron or sesquichloride of aluminium which may be contained in it. The neutralised liquor is then pumped up into an elevated cistern, in which it is left at rest for a few hours, in order that it may deposit certain solid matters which it now holds in suspension. The most abundant of these is usually sulphate of calcium, due to the somewhat considerable quantity of sulphuric acid which is nearly always coutained in the hydrochloric acid produced in alkali works; but there are also small quantities of sesquioxide of iron, derived from the sesquichloride of iron in the hydrochloric acid, and sometimes partly from the lime used in the process, and larger or smaller quantities of alumina and silica, due to the lime. These impurities having deposited, the supernatant liquor, which is a mixed solution of chloride of manganese and chloride of calcium, and is now quite clear, and of a beautiful rose-colour, is run off into another vessel, where there is added to it the quantity of lime necessary to decompose the chloride of manganese in it, and nearly an equivalent more. A blast of air is then injected into the resulting mixture, and what was at first a perfectly white mud (all the manganese in which was in the state of MnO) soon becomes a very black mud, nearly all the manganese in which is in the state of MnO_2. This is then allowed to settle for about twelve hours, at the end of which time it has separated into a denser black mud and a supernatant, clear solution of chloride of calcium. This solution of chloride of calcium having been drawn off, what remains is ready for use in the still. It is used as mud, without drying, being conveyed to the still by pipes, and entering by a hydraulic lute. In the still it meets with hydrochloric acid, from which it liberates chlorine, at the same time re-producing exactly such a residual solution as was commenced with. With this solution, the round of operations is re-commenced, and so on, over and over again, continually. The samples I exhibit are portions of a charge of manganese which, at the works of Messrs. J. C. Gamble and Sons, of St. Helen's,—where this process has been worked out, by the liberal co-operation of Lieut. Colonel Gamble, the proprietor of those works, and the invaluable assistance of Mr. Bramwell, the very able manager of them,—has actually generated chlorine from which bleaching-powder has been made, something like fifty successive times.

Hitherto, the principal item in the cost of chlorine has been that for native peroxide of manganese. Last year, in Great Britain, France, Belgium, and Germany together, there were produced about 120,000 tons of bleaching-powder, which cost, on an average, for native oxide of manganese, not much, if any, less than £5 per ton. My process substitutes for this cost for native oxide of manganese a cost for the regeneration of manganite of calcium not exceeding fifteen shillings per ton of bleaching-powder, being about ten shillings for lime, one shilling for steam, one shilling for wages, and two shillings for interest and wear and tear. Moreover, whereas hitherto, at least in this country, and in all but an extremely few exceptional cases, the production of a ton of bleaching-powder has required the acid from about 75 cwts. of salt: my compound yields chlorine enough for a ton of bleaching-powder from the acid from less than 45 cwts. of salt. This larger yield of chlorine is mainly due to the artificial manganite being so easily soluble that it can very readily be caused to neutralise from 95 to 99 per cent of the acid employed, which is a very much larger proportion than can be neutralised when working with manganese ores. A third very important advantage of the new process over the old one consists in this—that, whereas the immense quantities

of acid which escape neutralisation in the old process are usually—and have almost necessarily to be—sent into the rivers as free acid, the only product of the new process which has to be thrown away is a perfectly neutral solution of chloride of calcium.

Seeing that manganite of calcium, or $CaMnO_3$, is only of the very same value precisely in respect of the quantity of chlorine which it can liberate from a given quantity of acid as sesquioxide (otherwise manganite of manganese, or $MnMnO_3$), it may be well to explain why it is preferable to produce and re-produce the former rather than the latter. The reasons for this are two. There is, firstly, the obvious reason that, when all the manganese is converted into MnO_2, twice as much work is done per given bulk of material operated upon as when only half the manganese is converted into MnO_2; and this, of course, would be a very important consideration, even if the transformation of chloride of manganese into manganite of calcium occupied the same time as its transformation into manganite of manganese. Really, however (and this is the second reason), the former operation, in which all the manganese is converted into MnO_2, does not occupy more than one-fifth of the time required for the latter operation, in which only half the manganese is converted into MnO_2; and hence, while the manufacture of chlorine by means of perpetually-regenerated manganite of calcium effects the very considerable economy above stated, it is questionable whether chlorine could be manufactured by means of manganite of manganese regenerated by the same method so cheaply as by means of manganese ores.

The length of time which, when protoxide of manganese by itself is treated with air in the wet way, is required for its complete conversion into sesquioxide is very remarkable, and the fact that hydrated protoxide of manganese is somewhat freely soluble, alike in water and in neutral solution of chloride of calcium, would seem to have something to do with it. It is a curious fact that the peroxidation of protoxide of manganese by treatment with air in the wet way is greatly retarded by the presence in the medium in which the protoxide is suspended of any proto-compound of manganese in the state of solution. Thus, in a solution of either chloride or any other proto-salt of manganese, peroxidation will go on only extremely slowly; and solution of the protoxide itself, which will be present until the very end of the operation when protoxide alone is treated with air in the wet way, has the same retarding influence. On the other hand, when treating with air a mixture of protoxide of manganese and lime suspended in solution of chloride of calcium, there are formed solutions containing peroxide of manganese, in the presence of which peroxidation goes on with extreme rapidity. All these solutions are more or less deeply coloured, solution of the protoxide being without colour. I exhibit a sample of one of the coloured solutions, called by the workmen "the port-wine solution." The nature of these coloured solutions has not yet been fully investigated, but I believe them to consist of manganite of calcium dissolved in solution of oxychloride of calcium.

I may be permitted to mention, in conclusion, that, while there is every prospect, from the rapidity with which the new process of manufacturing chlorine has been and is being adopted both in this country and on the Continent, that, within a period to be measured only by months, nearly all the chlorine made in the world will be made by it, there is every likelihood that, in nearly all cases, a portion of the hydrochloric acid saved by it will be applied to the recovery of sulphur from alkali-waste. The chief reason why the recovery of sulphur from alkali-waste has been so little practised hitherto is that the manufacturers have considered it more profitable to use all their acid for the manufacture of bleaching-powder than to use any part of it for the recovery of sulphur; but the process which I have had the honour to describe will enable them to make even more bleaching-powder than they have made hitherto, and yet have enough acid left to permit of their applying to all their alkali-waste the only process for the recovery of sulphur therefrom which as yet has been found practically successful; and I am able to state that this application of a portion of the acid saved by my process will be extensively adopted.

ON ELECTRIFICATION.*

By THOMAS T. P. BRUCE WARREN.

ELECTRICIANS must have noticed this singular phenomena at the very earliest date of testing; but it is very certain that it has been until now regarded as an unintelligible and uncertain property of an insulator.

The paper read by Mr. Warren has contributed greatly to our knowledge of its effects, so that it no longer remains the inconvenience that it had been to electricians; for he has shown that the laws which it follows admit of being formularised.

We notice that these researches have been carried out on cores of Mr. Hopkin's manufacture, several miles of which were tested under the varied conditions stated by the author. He believes that the very excellence of Mr. Hopkin's insulated wires has enabled him to examine so completely the whole of the subject.

ON THE NEW METHODS OF ESTIMATING THE AMOUNT OF REDUCED PHOSPHATES.

By JOHN HENRY CHESSHIRE.

IN a case recently tried at the Gloucester assizes, a dispute arose whether reduced phosphates could be estimated correctly. Notwithstanding the weighty evidence of Dr. Voelcker and others to the contrary, it was decided in the affirmative, and it was proved by the results of a series of experiments, conducted by men of equal scientific attainments, who pronounced my method (the bicarbonate of soda process) to be the one upon which the greatest reliance could be placed.

The plan I propose is as follows:—Take 1 grm. superphosphate, extract the soluble part. To the residue add 5 grms. bicarbonate of soda, ½ of a litre of cold water, and boil from two to three hours; filter, wash, &c. To the filtrate add hydrochloric acid in excess, then tartaric acid and the magnesia mixture in the usual way.

I now propose to tabulate a series of experiments, showing, side by side, the results of the oxalate of ammonia, and the bicarbonate of soda processes.

No. 1. Action of 10 grms. bicarbonate of soda on 1 grm. Bedford and Cambridge coprolite, with a ½ of a litre of water, and boiling for two hours—soluble phosphate = 0·97 per cent.

No. 2. Action of 5 grms. bicarbonate of soda on 1 grm. Bedford and Cambridge coprolite, with a ½ of a litre of water, and boiling for two hours—soluble phosphates = 0·69 per cent.

No. 3. Action of 5 grms. bicarbonate of soda on 1 grm. (so-called) gypsum, with a ½ of a litre of water, and boiling for two hours—soluble phosphate = 0·83 per cent.

No. 4. Action of oxalate of ammonia on 1 grm. gypsum, with a ½ of a litre of water, and boiling for half an hour—soluble phosphate = 0·97 per cent.

No. 5. Action of 5 grms. bicarbonate of soda on 1 grm. gypsum, with a ½ of a litre of water, and boiling for two hours—soluble phosphate = 8·98 per cent.

No. 6. Action of oxalate of ammonia on 1 grm. gypsum, with a ½ of a litre of water, and boiling for half an hour—soluble phosphate = 8·45 per cent.

* Abstract of a paper read before the British Association, Exeter meeting, Section A.

No. 7. Action of 5 grms. bicarbonate of soda on 1 grm. steamed bone, with a ½ of a litre of water, and boiling for two hours—soluble phosphate = 0·69 per cent.

No. 8. Action of oxalate of ammonia on 1 grm. steamed bone, with a ½ of a litre of water, and boiling for half an hour—soluble phosphate = 2·18 per cent.

No. 9. Action of 5 grms. bicarbonate of soda on 1 grm. guano, with a ½ of a litre of water, and boiling for two hours—soluble phosphate = 1·25 per cent.

No. 10. Action of oxalate of ammonia on 1 grm. guano, with a ½ of a litre of water, and boiling for half an hour—soluble phosphate = 2·11 per cent.

I obtained these results, 4, 6, 8, 10, by taking care to have only a slight excess of oxalate of ammonia at the end of the half hour's boiling.

Nos. 1 and 2.—My usual results with bicarbonate of soda have been only ½ per cent, but, as ½ a milligramme makes a difference of about 1-14th per cent, the results are practically the same.

Nos. 3 and 4.—The so-called gypsum is the waste after the soluble phosphate has been extracted from a superphosphate made from a mineral phosphate. It contained 12·57 per cent unacted-upon phosphate.

Nos. 5 and 6.—A superphosphate made from Bedford coprolite. I extracted the soluble portion, and worked on the remainder for the reduced. It contained 2·01 per cent unacted-upon coprolite.

Nos. 9 and 10.—A sample of good guano, which I boiled for half an hour, filtered wash, &c., and worked on the remainder for the reduced.

You will see by these experiments that you can distinguish between reduced phosphates and unacted-upon coprolite; and, if Mr. Hughes will take care to have only a slight excess of free oxalate of ammonia at the end of half an hour's boiling, his results will not be so high.

83, Newhall Street, Birmingham,
August 20th, 1869.

ON THE

EXAMINATION OF WATER FOR ORGANIC MATTER.*

By R. ANGUS SMITH, Ph.D., F.R.S., &c.

(Continued from p. 30.)

There are two columns giving the amount of oxygen required by the Clyde water. One giving the grains is correct, but, in altering the mode of expression, an error occurred not in the original. The amount in the 2nd is in 100 millions.

Having had occasion to examine another stream, very slow, rather a canal, receiving sewage, and flowing about twenty miles, the following results were obtained with the chameleon:—

Oxygen Required by the Decomposed and Decomposing Matters.

Grains per gallon.	
2·835	1·205
1·249	1·630
1·949	1·205
1·170	1·453
0·425	0·425
0·815	0·177

The gradual diminution of the decomposed organic matter is here seen very plainly. As new sewage comes forward in certain places, the amount rises.

These numbers correspond entirely with the apparent condition of the stream; they do not, however, correspond with the total volatile matter, which was as follows:—

Volatile matter.	Fixed matter.
9·33	44·27
6·23	28·91
3·99	24·08
3·08	36·75
3·43	31·85
4·16	30·31
5·22	29·92
5·04	69·30

I believe the results obtained by the chameleon are more useful in a sanitary point of view than the other results.

Let us take another case.

When heavy rains drove the impure water forward, the chameleon gave the following:—

Oxygen in Grains per Gallon Required for the Decomposed and Decomposing Matter.

0·992	1·106
0·284	1·134
0·638	1·276
0·709	1·347
0·992	

In such a case, the ordinary analysis gave—

Volatile matter.	Fixed matter.
4·20	20·72
4·48	21·21
7·14	26·39
6·02	34·02
4·27	28·28
4·69	32·27

These latter do not at all show the fine distinctions made by the permanganate, which agrees entirely with our senses, and may be used instead of them for putrid substances.

The permanganate must be used with consideration, like all other chemical tests. We must be careful that there are no lower metallic oxides in the water, which will remove the colour as suddenly as the sulphuretted hydrogen from putrid matter. Much has been said against the permanganate; but nothing even pretends to do what it does. Those who neglect it leave out the putrid matter, or drive it off in boiling. If it is used as the only reagent the results are certainly without value.

Nitrites decompose chameleon instantly. They are the result of the oxidation of azotised matter, and must be estimated.

The decomposition of the chameleon may be caused by the organic matter present, or by nitrites, &c. The presence of nitrites or nitrous acid will show if the organic matter is only recently oxidised.

Generally, there may be found organic matter and nitrites together, showing that some is oxidised and some ready to become so.

Schönbein has found traces of nitrous acid in the efflorescence of walls. In judging of the time, we must make allowance for this, and not judge from small traces such as he alludes to.

When nitrites and organic matter are found together, they may be estimated separately: the chameleon will be decomposed by both. 158 of chameleon solid is equivalent to 95 of nitrous acid, or 1000=606. It will be necessary to find one of the substances separately, and to subtract it from the whole, in order to find the amount of the second.

The amount of nitrous salts may be found by using ozone-paper, that is, paper with iodide of potassium and starch. The water to be tried is made acid with a little dilute sulphuric acid—not more than three drops to 1000, and a drop put upon the paper. If nitrous acid is present, it becomes blue. This blue is obtained immediately by putting a drop of the solution on ozone-paper when there is 1 of NO_3 in 30,000 of water; and, by waiting patiently, and giving time, it may be seen with much less.

* From vol. iv., 3rd series, of the *Memoirs of the Literary and Philosophical Society of Manchester*. (Communicated, with emendations and alterations, by the author).

In order to find how much nitrite is in water, the solution may be diluted until the reaction ceases to be distinct, even after waiting. The amount in the water will then be 1 in 100,000. If, in another case, when we find the reaction distinct in water, we take 100 grains and add 900 to it and find it beginning to be indistinct, the undiluted quantity must have been ten times as strong as the diluted. The amount in the 1000 grains is 1 in 100,000; the amount in the 100 grains is ten times as great, or 1 in 10,000; and thus we may arrive sufficiently near to the total amount. The amount of water added in order to bring the reaction to the adopted minimum is the measure of the strength of the solution.

A test like this depends partly on the eye and partly on the delicacy of the test-paper. The same result will be attained if the same eye and tests are regularly used.

The method of testing with paper is not so refined as the use of a larger amount of water—say 1000 to 10,000 grains. With this amount, the presence of 1 of NO_3 in 3¼ millions of water may be detected on adding starch and iodide of potassium. Three drops of sulphuric acid are also added to the 1000 grains, *i.e.*, 3 grains by measure. If no nitrous acid is present, no blue colour will be seen with this amount. If nitrous acid is present, the colour will begin in a few seconds. Some may prefer one way, and some the other. I do not look on this as quantitatively very exact; I simply thought it a useful method. Some more work is required.

The methods given of estimating the amount of nitrous acid are minimetric, proceeding by dilution instead of concentration. The value with gases is better known than in liquids; but it is believed that it will be sufficiently exact with the latter in cases where pure scientific accuracy is not attainable and not necessary, and where it is important to save time, labour, expense, and patience.

Now suppose 1000 of the water decolourise 5 of chameleon, we must subtract from 5 the amount which would be due to the NO_3, which then would give the amount of chameleon solution decomposed by the organic matter.

The estimation of both is interesting; but it is much more important to obtain the total chameleon used, as the presence of NO_3 must be considered a great objection to water, partly on its own account, and chiefly because of its origin.

It is to be observed that water containing much animal matter becomes extremely acid. It is a common thing to find water extremely clear, with no apparent organic matter; even on standing, also, extremely acid, and retaining nitrates. I have found it so filled that it appeared to flow less readily than pure water, and had a most nauseous taste. It was close to a churchyard, and was considered excellent water. This perversion of taste is difficult to understand, but it must be combated; it is not natural, and causes illness and death. This acid water is an excellent solvent of metals; and, if lead is present, the solution becomes rapidly so strong as to taste of the metal. This acidity, in conjunction with nitrates, does not, so far as I know, exist when the organic matter is very old—probably because the organic acid is oxidised. Some of it—probably all—is caused by the formation of organic acids. Similar organic and entirely colourless solutions, acid, but free from nitric acid, may be found by allowing peaty water to stand, without evaporation, but in contact with the air, for some years.

In the nitrous waters, no organic matter will be apparent on burning, unless there is more than the acid can oxidise. A very white ash is, therefore, a suspicious circumstance; and, unless the matter is extremely free of organic matter, this white ash is a certain indication of nitric acid. If there is a great deal, the ash melts readily. By white is meant white as soon as it is incinerated.

These acid nitrous waters contain phosphates generally. Phosphate of lime, or even alumina and iron, may be precipitated from them by ammonia, if they are direct from animal matter, and have not passed through porous matter sufficient to deprive them of some of the less soluble substances.

There are many interesting questions to be asked regarding nitrates. I am inclined to think that their presence shows that the most dangerous state of the organic matter is past. When they appear in any solution, the chief escape of putrid gas seems to have ceased; the water may, however, be still dangerous to use, and, of course, is revolting to the imagination. It will be well to examine how far these suspicions are correct. When complete nitrification has occurred, all that class of evils arising from organic matter direct are prevented.

This paper was written for a special purpose, and does not pretend to say all that may be said regarding organic matter in water. As to the purification, there are many points to be observed. It has been generally held that nitric acid is the ultimate form which nitrogenous substances of organic origin assumes; but we must remember that plants have the power of decomposing nitrates, and of using the nitrogen for their own purposes. There are conditions, therefore, in which the organic matter may be entirely removed from water; and, when we remember how readily soils absorb phosphates and potash, we easily see why common salt should chiefly be left. The oxygen of the nitrates may even be used for the purification of water, whilst the earthy salts and phosphoric acid are precipitated. This operation of decomposing the nitrates seems to be the final one which is at hand for purifying water, and probably explains the marvellous results we frequently see. This decomposition is performed by living plants apparently; but some observations seem to indicate that the effect may be produced by the organic dead matter in water. The nitrites found in plants by Schönbein may possibly have been formed from the nitrates by deoxidation.

Animal and Vegetable Matter—The Common Salt of Sewage.

This subject deserves a further separate treatment.

As animals are formed out of vegetables, the elements which compose each are of course the same; and even the proximate organic principles are difficult to distinguish, especially in a state of decomposition. Still, it is remarkable what a clear insight is given into the quality of water by simply boiling down a few thousand grains and burning the residue. We can, by the eye and the smell, detect humous or peaty acids, nitrogenous organic substances and nitrates, and estimate their amount to a very useful point of accuracy. There may be times when this is the only experiment that can be made. After doing this, and trying other methods many hundred times, I still return to it as delicate, and little liable to fail. The want of numerical results is a serious objection, rendering the plan unfit for use when public reports are to be made of the analyses; but it is an excellent guide for the chemist in his laboratory: we may even decide by it the animal or vegetable origin of the matter.

This, however, is not enough; we require to obtain some knowledge of the quantity as well as of the quality, and we even require to know something of the previous history of the water, supposing decomposition to have gone so far that nothing definite can be affirmed as to the organic substances. It has already been shown that the carbon and the nitrogen may entirely disappear, the phosphorus may be precipitated, and the sulphur be, to a large extent, removed, nothing whatever remaining of the original substances, except alkalies, some of the alkaline earths, and chloride of sodium, or common salt. The latter, in reality, is the only substance which, so far as I know, is neither dissipated nor precipitated in whole or in part, potash excepted. The common salt, therefore, may be taken as an indication of the amount of original or organic matter, if we subtract from it any portion which we know to have appeared originally connected only with inorganic substances.

Perhaps all natural waters contain common salt;

although rain, in a quiet day, and in a clear district, is nearly free from it, possibly, in some places, entirely so. In passing through the soil, it always collects some chlorides; some of these are the measure of the amount of vegetable matter decomposing in the soil. If we were to estimate the amount of chlorides dissolved by the water alone out of the inorganic soil, and subtract that from the total, we should obtain the amount dissolved by the action of vegetation breaking down the rocks or soil allowing for rain also. If the organic matter were decomposed, the common salt would still flow down the streams, and tell its tale. These quantities, however, vary excessively on every soil, and in every climate, and with every wind, and degree of wind.

The common salt which comes down our streams comes from the wear and tear both of animals and vegetables in the process of living. We cannot tell which comes from the animals and which from the vegetables.

From pasture-land, and land generally, the greatest amount is from vegetation; and, if we collected the organic matter, we should find also there that vegetation gave the greatest amount of matter, except from recently-manured fields, or when the water comes from shallow or surface drains, where the land had upon it a good deal of animal matter.

When, however, we come to towns, or great collections of animals, the chlorides, as well as the organic substances with which they are allied are the products mainly of changes taking place in animal life. Let us compare the amount of chlorides to be found in plants and in animals.

Chlorides in the Blood of Animals (Nasse and Poggiale in Gmelin) *as Chloride of Sodium in* 1000 *parts.*

Dog	4·490
Cat	5·274
Horse	4·659
Calf	4·804
Goat	5·175
Sheep	4·895
Rabbit	4·092
Swine	4·281
Goose	4·246
Hen	5·396

If we take the ashes, the amount is, according to Stölzel,

For ox blood	51·190
For ox flesh	4·860
Ashes of the serum in man*—	
Chloride of sodium	61·087
Chloride of potassium	4·085
The ashes of the blood in man	57·641
The ashes of the blood of the horse, according to Lehmann	67·105
Urine	22·972

But, as the latter is produced so rapidly and frequently, it is the greatest and most constant source of common salt. No plant can be compared with animals in this respect.

CHLORIDES IN VEGETABLE MATTER.

Ashes. Name of Plant.	Chloride of Sodium.						Chloride of Potassium.					
Wheat grain	0·27	0·55	0·64	1·60	0·34	Way and Ogston.						
In the whole ash		10·00	Weber.									
Ripe oats. Grains		0·92	0·07	0·45	1·24	Way and Ogston.						
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Buckwheat straw	4·55	3·01	3·19	3·75	3·38	1·69 E. Wollf.	7·41	26·93	0·77	3·13	6·85	9·70 E. Wollf.
Barley straw with chaff		3·07	5·68	2·14	4·37		..	..	0·90			
			5·56	Way and Ogston.								
Barley grains	0·56	1·44	0·41	0·61	0·72	1·59 ..	..	..	1·29			
			2·01	..	..	.. .. ..	..	..	1·93			Way and Ogston.
Ripe oat straw, Middle			3·03									
" " Bottom			15·36	J. P. Norton.								
Radishes. Root			10·89	Herapath.								
Chestnut.												
Young wood								9 67				
Green shell								15·42	2·20	Wollf.		
Asparagus		7·97	Schlienkamp.			12·94 T. Richardson.						
Tea	2·40	2·15	2·25	4·66	3·25							
	Spooner.		Twis.	Hague.	Homes.							
Orange-tree. Root			1·18									
" " Stem			0·25	Rowney and Blow.								
Beech		6·68	0·62	Witting.								
Birch		7·17	9·84	Witting.								

When animals decay, they must, according to the above analyses, give out much more common salt than the same amount of vegetable matter; and this we find to be the case in the drainage of grave-yards. But it is from living animals we find the greater amount of common salt: that which goes into the blood is rapidly thrown out; and, as we take with our food amounts varying from 100 to 250 grains of common salt per day—let us say 150, an equal amount must be abstracted from us. It is for this reason sewage water constantly is found to contain common salt, increasing according to the amount of sewage. For this reason, common salt is found in the saltpetre of all countries. It is a part taken from the blood of the dead or the living animal, remaining with the nitrogen unchanged, even when the organic matter has been so

* Robin and Verdeil's "Traité de Chimie Anatomique."

highly oxidised that nitric acid takes the place of albumen.

Pure spring, or very fine stream water, gives only a slight precipitate with nitrate of silver. This has a bluish tinge, not being dense enough to become white. When there is more than this slight precipitate, nitric acid is generally found, especially if the water has passed through porous materials.

These tests must be used and the inferences drawn with great discretion. We know that near the sea there may be found a certain amount of chlorides in the springs, rising, according to circumstances, until the water becomes brine. The same thing occurs near great deposits of salt, such as in Cheshire and elsewhere. There are, also, saline wells scattered over most countries, the origin of whose chlorides is quite unknown to us. There is in the rain driven violently from the sea an amount of common salt sufficient, on crystallising, to dim the windows of houses many miles inland. In manufacturing towns where coal is burnt, the rain contains more chlorides than rain in the country. Many large districts of tropical countries contain nitrates and common salt in the soil, but these salts in all probability result from oxidised animal matter. Chlorides are found in some districts in this country rather in excess of the average from superficial causes. But notwithstanding all these exceptions, which appear for the moment numerous, I must still consider that the test is one which may be generally used.

In England it is almost universally the case that the presence of much chloride in drainage water indicates drainage from animal matter, and no water containing chlorides to a great extent ought to be used without careful examination as to the source. One grain per gallon is too much, and is, in many places, to be suspected of being caused by impure drainage. Of course we must in this case, as in all inquiries, be careful that no disturbing causes intervene. In this country chlorides may be given out from manufactories, in which are constantly made chemical experiments sufficiently large to interfere with our accuracy, if we are not very careful.

It may be supposed here that I am adding many qualifications, but the same may be done in the case of nearly all experiments. No experiment is of value, unless it is viewed on all sides to prevent the admission of errors, and I do not know that more care is required in this case than in many others. In the case of chlorides we learn readily the average amount in a district, either in the rain or the drainage, and we detect the smallest increase. Any amount of common salt above the average of the district obtained in a well in a city or camp, or near habitations of men or animals, is an almost certain proof of impure drainage; when the clue has been followed up, I have found the origin in a sewer or some such spot, times without number and for many years. The presence of the sea or manufactories, or of disturbed strata with mineral waters, will seldom, after all, cause any error with a careful person.

Nitrates are very common in small quantities. They are found in water from manured land, in gardens, wells near houses, and, as a consequence, in nearly all town wells; in great abundance near churchyards, if the drainage is direct. They are not necessarily found in sewage which has not flowed through strata. The amount from the atmospheric sources is so minute that it will not interfere with any inquiry regarding the wholesomeness of water at present.

Although caution must be exercised in drawing conclusions from the presence of the chlorides, their absence may be held as conclusive against the presence of decomposed animal matter, and excretions of animals in large quantities.

If chlorides and nitrates are found together in water, we may take it for granted that animal matter has existed there, or does exist in the water. Of course a very rigid scientific inquiry shows at once that vegetable matter may be present, especially from grain or seeds; but, practically, this need not affect the question, especially in a sanitary point of view, because, if this accumulation of vegetable matter occurred capable of giving as much nitrogen as animal matter, it would be sufficiently, and perhaps equally, hurtful when putrid.

If chlorides and nitrates are found in water still capable of decomposing chameleon, the presence of animal matter, or injurious gases or nitrites, may be assumed, a part only being oxidised.

If the chlorides and nitrates are present, but the power of decomposing chameleon absent, then animal matter in a putrefying state is absent, but whether it disappeared minutes or ages before is not shown by chemistry.

The chloride of sodium in a sewage stream of a very sluggish nature was estimated. The following numbers were obtained in a course of 14 miles:—

8·97	7·93
7·53	7·78
6·25	6·62
7·78	40·89

The numbers are pretty uniform, although they rise and fall with evaporation and the additions made to the stream; but whenever certain manufactures come in a sudden rise is observed. Before this occurs, I believe the chloride of sodium is a perfectly exact comparative measure of the amount of sewage. It may, in many cases, also be made into a positive measure. This will, however, depend on the mode of managing the sewers.

The conclusion simply is, that chloride of sodium is the most abiding constituent of sewer water, and, with due precaution, the best index of comparative amounts in the original sewage. When decomposition has not taken place, it may also be used for indicating the comparative strength or value of sewage water.

Perhaps it will be thought that in here speaking of the impurities of water, when the River Commissioners are making their inquiry in Lancashire, it would be better if I spoke less of the laboratory side of the question, and more of the great evils which have destroyed the beauty and use of our rivers. On one important point I am of the same opinion which, years ago, I expressed in this Society—that we waste an enormous amount of water. We throw into a stream, without compunction, impurities which will destroy the value of many hundred times, or, perhaps, thousand times, their bulk; and this evil may, to a certain extent, be cured with our present knowledge. We try in vain to take out that which we have thrown in. A large part of the evil can be cured by little trouble, although I confess that there is much remaining which demands more time and space than is everywhere conveniently found. Time and space, although by many treated as mere forms of thought, are expensive in Lancashire.

The following may be regarded as a summary of the results required for sanitary purposes:—

1. Quality of the organic matter.
2. Condition of the gases of decomposition.
3. Organic matter: easily-decomposed organic matter, and slow to decompose.
4. Nitrates as remnants of organic matter.
5. Nitrites.
6. Chlorides, with precautions, as indicating animal sources when greater accuracy is wanted.
7. Oxygen of the dissolved air as indicating the activity of the decomposition.
8. Total organic matter.

(This the author found by weighing).

9. The usual inorganic analysis, to be spoken of in a second paper.

The author considered that, for purely sanitary purposes, the Nos. 1, 2, 3, and 6 were the most important.

The organic matter may be divided into many parts; nitrogenous into several parts; and carbonaceous into several. The total nitrogen has been taken by Dr. Frankland very carefully, and the mode of taking oxides of nitrogen improved. The division of the nitrogenous into separate parts has been begun by Wanklyn. The carbonaceous has not been much studied of late years.

ON SOME NEW SUBSTANCES EXTRACTED FROM THE WALNUT.*

By Dr. T. L. PHIPSON, F.C.S.

BETWEEN the shell and the kernel of the walnut there exists a thin membrane, called the episperm, which closely envelopes the cotyledons, and is composed here, as in most other fruits, of a double membrane, the inner one being very thin, quite white, translucid, and perfectly devoid of taste, whilst the external one is much coarser in structure, more or less coloured, has a very bitter, disagreeable taste, and contains the substances mentioned in this paper.

When the episperm of the walnut is digested for several hours in alcohol, it yields a yellowish liquid, from which a notable amount of gallic acid, ellagic acid, and a new species of tannin, which I will call *nucitannic acid*, or *nucitannin*, can be obtained. The latter is the principle to which the thin walnut skin chiefly owes its disagreeable bitter taste; and this nucitannic acid possesses the property, when boiled for several hours with dilute hydrochloric acid, of splitting up into *glucose* and a red substance, which I will call *rothic acid*, the composition and properties of which I have fortunately been able to determine, although I started on this research last season with a very small supply of walnut skin.

Nucitannin is soluble in water and in alcohol, very slightly soluble in ether; it precipitates solution of gelatine, but not exactly like ordinary tannin does. The mixture solidifies only after a little time. It forms insoluble salts with lime and oxide of lead, and is left as a kind of yellow varnish, devoid of crystallisation, when its alcoholic solution is evaporated at a moderate temperature. Its composition has not yet been ascertained.

When an aqueous solution of nucitannin is boiled for eight or nine hours with dilute hydrochloric acid, the pale yellow liquid becomes more and more red, until it finally assumes a tint similar to that of a dilute solution of permanganate of potash. It is then allowed to cool, when the red substance, rothic acid, separates, along with some gallic acid and ellagic acid; these are collected on a filter, and the clear liquid which passes is found to contain glucose and gallic acid.

Rothic acid is separated from the other substances by a dilute solution of ammonia, and re-precipitated by hydrochloric acid; a second treatment gives it quite pure. It is a brownish red amorphous substance, combining readily with ammonia, potash, lime, &c.; its lead-salt is remarkable by being insoluble in cold acetic acid. Rothic acid is very soluble in alcohol; its solution exercises no particular action on the spectrum; it yields no absorption bands; it is, also, very soluble in ammonia. Dried at 100° C., it was found to lose water for a long time; it was, therefore, heated in an oil-bath to 118° C., and then burnt with chromate of lead. The analysis gave:—

		Calculated for $C_{28}H_{12}O_{14}$.
Carbon	57·81	.. 57·52
Hydrogen..	4·16	.. 4·11
Oxygen	—	.. 38·37

The lead-salt was formed by precipitating acetate of lead with an alcoholic solution of rothic acid; it forms an olive-coloured amorphous precipitate, which becomes brown when dried in the air, and appears quite black when dried at 100° C. It leaves metallic lead when calcined carefully in a porcelain crucible. 370 milligrms. of rothate of lead yielded, to analysis, 150 milligrms. of lead, or 40·5 per cent.

Calculated for $C_{28}H_{12}O_{14},2PbO$.	Found.
Lead, per cent .. 40·2	40·5

The lime-salt of rothic acid forms a brownish precipitate, obtained by adding an ammoniacal solution of chloride of calcium to a solution of rothic acid. It is like the lead-salt in appearance, but contains only one equivalent of base:—

$$C_{28}H_{12}O_{14},CaO.$$

The rothates of potash, soda, and ammonia are soluble; the rothate of silver forms a fawn-coloured precipitate, which becomes darker on drying, but does not appear to be very sensitive to the action of light.

Rothic acid is a member of a rather numerous class of bodies, some of which are mentioned below:—

$C_{28}H_{12}O_{14}$ = 1 eq. rothic acid.
$C_{28}H_{12}O_{20}$ = 2 ,, gallic acid.
$C_{28}H_6O_{16}$ = 1 ,, ellagic acid.
$C_{28}H_8O_{16}$ = 2 ,, rufigallic acid.

Somewhat similar substances extracted from oak-bark, quinine bark, root of *Tormentilla erecta*, &c., appear, on analysis, to contain C_{26} instead of C_{28}.

I will reserve for a future occasion, an account of the preparation, properties, and composition of pure nucitannin; I may briefly state, however, that the alcoholic decoction of the walnut skin contains a substance described here as nucitannin, yielding, by the action of mineral acids, rothic acid, gallic acid, ellagic acid, and glucose; and, since ordinary gallotannic acid may be represented as a glucoside, yielding 3 eq. of gallic acid—

$$S\left\{\begin{matrix}G\\G\\G\end{matrix}\right\}-8HO,$$

it is possible that nucitannin may be—

$$S\left\{\begin{matrix}R\\G\end{matrix}\right\}-xHO,$$

in which R represents rothic acid, and takes the place of 2 eq. of gallic acid. If so, there is another tannin present in the walnut skin, an *ellagic tannin*—

$$S\left\{\begin{matrix}E\\G\end{matrix}\right\}-xHO,$$

which explains the fact that alcohol takes up, from the walnut skin, a substance yielding a notable amount of ellagic acid, these glucosides being all very soluble in alcohol, though the acid derived from them may be very much less soluble.

* Read before the British Association, Exeter meeting, Section B. Abstract by the author.

NOTICES OF BOOKS.

Abridgments of Specifications Relating to Acids, Alkalies, Oxides, and Salts. A.D. 1622—1866. Printed by order of the Commisioners of Patents. London, 1869.

WE have here before us, condensed into a neat volume containing about 1100 small octavo pages, a most useful as well as a most valuable record of the history and course of inventions on the domain of practical and technical chemistry for a period of nearly two and a half centuries. The number of specifications, from the earliest period to the end of the year 1866, amounts to no less than 59,222.

This work, besides embracing all inventions relating to the making or obtaining by any direct or indirect methods of acids, alkalies, oxides, or salts, includes inventions relating to the making or obtaining of several elementary bodies; among which are bromine, iodine, chlorine, fluorine, carbon, hydrogen, nitrogen, oxygen, and sulphur, and some compounds—as, for instance, cyanogen.

There is in this excellent work such an *embarras de richesse* as regards the subjects for quotation that it is very difficult to make a choice out of such an abundance of matter. For curiosity's sake, we quote, from the first page, the following:—

A.D. 1623, February 23, No. 23.—Jones, Roger, and Palmer, Andrewe, "Makeing of hard soape with a material called berilia, and without the vse of any fire is the boyling and makeing thereof; and also of makeing of

soft soape without the use of fire in the boyling thereof." The "berilia" consists of ashes of "beanestrawe," "peasestrawe," and of English kelpe. *Qucritur*—What is, in this phrase, the meaning of the words "without fire?" does it refer to saponification in the cold? or was steam already used by some for boiling other liquids? Since no specification is enrolled, this question remains unanswered.

This work, to which are added copious indices of subject matter, and of names, will be highly welcomed, both by manufacturers and parties directly interested in patents, and specifications thereof; the work is a valuable addition, also, to the scientific bookshelves and libraries of the day; and the whole manner of execution and abridging of abtruse matters, too often very imperfectly worded, reflects great credit upon the gentlemen to whom the excellent head of the Patent Office has entrusted a task which deserves the praise of all who can understand the difficulty of the proper execution of that task.

Notwithstanding that the book contains nearly 1100 closely-printed pages, it is sold at a very reasonable price, while the paper and typographical execution are also commendable.

MISCELLANEOUS.

Vorläufiges Programm der 43. Versammlung Deutscher Naturforscher und Aerzte, Innsbruck, 1869.—From the printed programme above named, we abstract the following:—The meeting begins on the 18th, and ends on the 24th of September, and will be held at the town of Innsprück, Tyrol. Although this meeting is chiefly an association of German natural philosophers and medical men, foreigners are very welcome, and are admitted as members the same as Germans, on payment of three thalers (nine shillings). Tickets for membership are obtainable by application to Prof. Dr. O. Rembold, Innsprück, on payment of the sum just mentioned; and on the 17th and 18th of September next tickets are to be had at the Hotel de l'Europe, opposite the railway-station of the town of meeting. The following sections are arranged:—Mathematics and Astronomy; Natural Philosophy (Physics) and Mechanics; Chemistry and Pharmacy; Mineralogy, Geology, and Palæontology; Botany and Phytophysiology; Zoology; Anatomy and Physiology; Medicine; Medical Reform; Surgery and Ophthalmology; Gynæcology and Midwifery; Psychiatry; Naturwissenschaftliche Pædagogik (the manner of teaching natural sciences in lower schools); Public Hygiène and Forensic Medicine; Medical Practice of Infants and Young Children; Anthropology and Ethnology; Military Medical Practice. The first general meeting is appointed to take place on Saturday, the 18th of September. Several excursions of interest in the beautiful neighbourhood of Innsprück have been arranged to take place; and most of the German and other Continental railway companies intend granting facilities for the conveyance of visitors to this meeting at greatly reduced tariff.

Explosion caused by Ammonia Gas.—M. Werner.—On the 18th of February last, an explosion took place at the chemical works of Messrs. Kunheim and Co., Berlin. It appears that a large iron vessel of cylindrical shape, 6 feet in diameter, and 4½ feet high, and 13-16ths of an inch in thickness, was used for the evolution of ammonia gas from a somewhat thickish magma; but this operation had been carried on in the same manner for twenty years, and with iron vessels of similar description, which were properly renewed when required. It was this apparatus which exploded; and the author states that the vessel was strong enough to withstand a pressure of 20,000 pounds to the square inch. The apparatus have since been provided with safety-valves; for it appears that the explosion took place immediately after the apparatus had been filled with about 4000 lbs. of ammoniacal liquor, and that the explosion was the joint effect of steam and ammonia gas. The iron apparatus was found to be throughout well made, of good quality and strength, and only a suddenly-applied force would break it.—*Zeitschrift des Vereines Deutscher Ingenieur.*

Testing Acetic Acid.—The value of commercial acetic acid can be estimated by ascertaining how much soda, or carbonate of soda, a given weight can neutralise. Inorganic acids, if present, would also neutralise the alkali; they must be tested for separately, or the determination corroborated, by evaporating the neutralised liquor to dryness, and calcining it at a red heat. All the acetate of soda is then converted into carbonate, the quantity of which may be dosed by the test acid; if it corresponds in quantity with the alkali first required to neutralise the acid, there is no mineral acid present; if it falls short the difference may be ascribed to some mineral acid, the soda-salt of which is not decomposed by red heat. Good commercial acetic acid contains from 18 to 22 per cent of anhydrous acetic acid, and traces only of sulphates and chlorides. When 100 grains of acetic acid neutralise 62 grains of crystallised soda, the acid contains 23 per cent of anhydrous acetic acid. Acetic acid should be tested for lead and copper, for sulphuric, hydrochloric, and nitric acids, should be entirely volatile on being boiled, and, when concentrated, its vapour should readily ignite on being approached by any flame. The strength of vinegar can also only be determined by the same means as indicated for acetic acid. When acetic acid or vinegar are evaporated to dryness on a water-bath, after addition thereto of a few drops of a strong clear solution of loaf-sugar, there should not ensue a deep brownish or black colouration on the residue becoming dry, which would indicate the presence of sulphuric or hydrochloric acids. Vinegar always contains sulphates and chlorides, and, if deeply coloured, also organic matter; the presence of the salts just named is due to the water applied in making the vinegar. Acetic acid should be free from tarry matters and aceton; they will be discovered on gently evaporating, and also on saturation, best with pure carbonate of lime.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, August 23, 1869.

This number contain the following memoirs and communications bearing more especially upon chemistry:—

Researches on the Ethereal Derivatives from Propylic Alcohol.—MM. Pierre and Puchot.—Iodide of propyl, prepared by the reaction of phosphorus upon a mixture of pure propylic alcohol and iodine, exhibits, after repeated purification, a colourless liquid, having a sweetish, somewhat alliaceous odour, boiling at 104·5°; sp. gr., 1·784 at 0°. When this fluid is exposed to air, it is slowly decomposed, and iodine is set free.—Valerianate of propyl, prepared by distilling a mixture of pure propylic alcohol, pure valerianate of potassa, previously dried, and sulphuric acid, very cautiously and gradually added to the mixture, is, after having been purified, a colourless liquid boiling at 157°; sp. gr. at 0°, 0·887.—Butyrate of propyl, $C_8H_7O_3,C_6H_7O$, is obtained by the very cautious distillation of a mixture of previously-dried butyrate of potassa, propylic alcohol, and sulphuric acid. After repeated rectification, a fluid is obtained which boils at 137·25°, is colourless, and exhales the odour of fruit and herb of mint, mixed; sp. gr. at 0°, 0·888.—Acetate of propyl, $C_4H_3O_3,C_6H_7O$, is prepared by distilling a mixture of propylic alcohol, dried acetate of soda, and sulphuric acid. After repeated rectifications, a very limpid, colourless, agreeably-smelling liquid is obtained, boiling at 103°. Sp. gr. at 0°, 0·910.—Formiate of propyl, C_2HO_3,C_6H_7O. After rectification, a liquid is obtained boiling at about 83°. Sp. gr. at 0°, 0·9197.—Propionate of butyl, $C_6H_5O_3,C_8H_9O$, is obtained by distilling a mixture of previously-dried propionate of potassa, butylic alcohol, and sulphuric acid, after repeated distillation and rectification of the raw liquid first obtained. The pure ether is a very fluid, colourless, agreeably-smelling liquid, boiling at 135·7°. Sp. gr. at 0°, 0·8934.—Propionate of ethyl, $C_6H_5O_3,C_4H_5O$, obtained by distilling a mixture of previously-dried propionate of potassa, pure strong alcohol (95 per cent), and sulphuric acid. The purified liquid boils at 100°; its odour is somewhat akin to that of acetic ether. Sp. gr. at 0°, 0·9137.

The Metrical System.—M. J. Dumas.—The report of the committee on this subject, of which this eminent *savant* is the spokesman, reviews the labours of a very select committee of eminent men, representing not only France, but also Switzerland and Holland, who commenced their work in the year 1790, and finished it on the 4th of Messidor, of the year VII. (23rd of June, A.D. 1800). The present committee recommends that the standards of weights and measures in the custody of the Academy shall on no account whatever be altered or tampered with in any way. Since these standards have been made and verified by an international committee of *savants*, and every care was taken to ensure the perfection of these standards, the committee also recommend that the French Government shall give permission to delegates of foreign nations to get copies made of the standards alluded to under proper supervision, and that these delegates do take what care they deem proper to ensure correctness of these copies.

Manufacture of Special Kinds of Pig-Iron.—M. Jordan.—This is a metallurgical memoir, wherein the author discusses the calorific phenomena produced by the injection of jets of air, steam, or oxygen into molten cast-iron. The tendency of this paper, is entirely practical, and it is, moreover, too lengthy for useful abstraction.

Chloride of Acetylen and the Synthesis of Julin's Chloride.—MM. Berthelot and Jungfleisch.—Instead of making chlorine in free state act upon acetylen, the authors have applied chloride of

his researches, consisted, in 100 parts, of:—Lime, 18·89; boracic acid, 46·11; water, 35·00. Since the time this analysis was made, the mineral locally known as teza has become an article of commerce, and is brought over to Europe with the view of being applied to the manufacture of boracic acid and borax. According to the author, this mineral, which is chiefly found in nodules among the nitrate of soda beds of Peru, when dried at 100°, has, in 100 parts, the following composition:—Borate of lime, 52·39; borate of soda, 10·23; sulphate of soda, 1·06; chloride of sodium, 3·76; residue insoluble in acid, 4·23; water, 28·33.

The Manufacture of Borax from the Native Borate of Lime.—Dr. Graeger.—The author states that, since he found that what is stated in treatises and handbooks on chemistry concerning pure borate of lime is generally quite erroneous, he commenced by studying the properties of that substance more minutely. Pure borate of lime is only slightly soluble in pure water, 100 parts of which, at about 18°, only dissolve from 0·304 to 0·333 parts of that salt; boiling water does not dissolve, perceptibly, more of this salt. A solution of pure borate of lime in water behaves, with the following reagents, in the following manner:—Ammonia, no precipitate; caustic potassa solution, very slight precipitate, due to a trace of carbonate present along with the caustic alkali; carbonate of ammonia, copious precipitate, soluble in excess of precipitant; carbonates of potassa and soda, permanent precipitates; neither the nitrate of protoxide, nor of peroxide of mercury, nor, also, neutral chloride of iron, exhibit any reaction with the solution in question; solution of sulphate of copper gives a greenish blue precipitate. Since borate of lime is less soluble, even in alcohol, than sulphate of lime, a solution of the former salt in water containing only 1000th part of the salt is readily precipitated by alcohol containing 60 per cent of absolute alcohol. The presence in solution in water of some salts, especially chloride of sodium and ammonium, largely increase the solubility of borate of lime in water. Such acids as form with lime readily soluble salts, do readily dissolve borate of lime, both pure and native; and from such solutions, if concentrated, boracic acid is precipitated. The portion of this paper relating to the manufacture of borax and boracic acid from the native borate of lime alluded to, is rather a practical receipt for the proper performance of this branch of industry, and, therefore, not well suited for abstraction, the less so as the price of fuel, soda, and other things necessarily influence the applicability of the borate of lime for that purpose.

Glycerine as a Substitute for Spirits of Wine for the Preservation of Zoological and Anatomical Preparations.—Dr. Koller.—The author recommends concentrated glycerine as being cheaper, not liable to evaporation, not combustible, and, moreover, as better preserving the natural colour of various preparations usually kept and preserved in spirits of wine. According to the author, glycerine answers this purpose eminently.

New Method of Fusing Difficultly Decomposable Minerals.—Dr. Vorwerk recommends that 1 part of the previously very finely-powdered mineral should be mixed with 3 parts of fluoride of sodium, and that this mixture, after having been placed in a platinum crucible, should be covered with 12 parts of powdered bisulphate of potassa. Minerals such as chrome iron ore, hard hæmatite, tin ores, and rutile, corundum, and the like, are very readily brought to fusion and disintegrated by this flux, even with no more heat than that obtained from a good Bunsen gas-burner.

Sindor Oil and Sindor Balsam.—M. Maier.—These substances are used externally, in some diseases of the skin, by the Javanese. The real sindor tree belongs to Borneo, and is called there pohon-sinampar. The balsam investigated by the author has the consistency of balsam copaivæ, and exhibits a smell not unlike the latter substance; sp. gr. at 27·5°, 0·9221. The sindor balsam boils at 255°; burns, when heated to a higher temperature, with a flame emitting much soot and smoke; on being distilled along with water, the balsam left a reddish brown-coloured transparent resin. The balsam is difficultly soluble in alcohol, and on being brought into contact with strong sulphuric acid, became blood-red coloured. The essential oil, obtained by distilling the balsam with water, was of a light yellow colour, very fluid, boils at between 245° and 250°; sp. gr. at 27°, 0·914; soluble in from 4 to 5 parts of cold, and from 1 to 1½ parts of hot alcohol. The author extended his researches to other balsams, which, though bearing the same name, are evidently either obtained from different trees, or have undergone peculiar preparations whereby their physical and chemical properties are very much altered. As to the trees yielding these balsams, the eminent botanist, M. Teysmann, who has resided for upwards of forty years in Java, states that they are not precisely known.

Distinction between Gum Arabic and Gum Senaar.—M. Schlosser.—According to the author, these two kinds of gum are not, as generally supposed, different only in quality from each other, but the senaar gum is undoubtedly derived from another tree. The behaviour of these two kinds of gum with acetate of lead is, according to the author, a ready means of distinguishing between the two with certainty; take 3 grms. of pure gum arabic, dissolve in 15 grms. of water, add gradually, and whilst stirring the mixture, 30 grms. of acetate of lead (from the wording in the original, it is impossible to infer whether an aqueous solution is meant or the dry salt in powder) there thus ensues a whitish precipitate, forming a rather thickish magma, which is transferred to a filter, the filtrate, about 18 to 20 grms., running off, exhibiting a hardly even opalescent fluid; the filtration is finished in an hour's time, and the residue left on the filter is no more fluid; take about 6 grms. of the filtrate, add 5 grms. of pure water and 1½ grms. of liquid ammonia, specific gravity 0·960, the fluid will remain quite clear, and even if, after twelve hours' time, a sediment were deposited, this does not amount to more than ¼ c.c. When gum senaar is treated in the same way it yields a milky filtrate; the filtration is extremely slow, and even after twenty-four hours the substance on the filter appears fluid. When 6 grms. of this filtrate are treated precisely as just described, the contents of the test tube, on being shaken about, become solidified, exhibiting a gelatinous mass.

A New Preservative Against Fire.—M. Reinsch.—The author states that, having been requested to report to a fire insurance company about the best means of preventing timber bursting into flame, he experimented with various salts, and at last came to the conclusion, as the result of his experiments, that impregnating timber with a concentrated solution of rock salt is as good, if not better, a preservative against its bursting into flame as water glass (silicate of soda), while the price of the former salt is, of course, only a mere trifle; moreover, rock salt thus applied to timber is a preservative against dry rot and noxious insects. The author recommends the use of salt water, that is to say, a solution of rock salt of moderate strength for the use of fire engines during a fire as by far more effective than water; but in order that the salt should not injure the working parts of the engines, they will immediately afterwards have to be played with fresh water again.

Cosmos, August 28, 1869.

This number contains, amongst its very varied information, the following:—

What becomes of Old Shoes.—They are cut up in small pieces, and these are put for a couple of days in chloride of sulphur, the effect of which is to make the leather very hard and brittle. When this is found to have been effected, the material is withdrawn from the action of the chloride of sulphur, washed with water, dried, ground to powder, and mixed with some substance which causes it to adhere together, for instance, shellac or any other resinous material, or also good glue or thick solution of gum; it is then pressed into moulds and shaped into combs, buttons, knifehafts, &c.

The Poisoned Fountain.—In La Limagne, Département Puy de Dôme, France, carbonic acid is nearly everywhere given off in smaller or larger quantity from the limestone formation which occurs there. Near Aigueperse, a town in the Département just named, a locality exists which is popularly named the "poisoned fountain;" it consists of a round hole placed in a depression of the soil, and this hole contains somewhat turbid water, from which carbonic acid constantly escapes, accompanied by a noise as if steam were blowing off from the safety valve of a steam boiler. It often happens that birds and other animals which come near this hole to drink from the water it contains, are asphyxiated at once by the carbonic acid. Such sources are often found in volcanic districts; near Naples the well-known "Grotto del cane" occurs, and the "Death valley" in the island of Java is the most extensive instance of this kind known.

NOTES AND QUERIES.

Aniline Colours.—Can any of your correspondents kindly favour me with the best and cheapest method of dissolving aniline colours suitable for calico-printers?—Alexis.

Tungstate of Soda.—Can you tell me if tungstate of soda is a conductor or non-conductor of heat, and where I can get it, and price? I want it to make paper fireproof, or can you tell me of anything else that will make paper fireproof, and at the same time a non-conductor of heat, and cheap?—Alfred Burn.

Printing Scarlet.—Can any of your courteous readers inform me of a substance that will prevent a solution of bichloride of mercury from being decomposed when boiled in a copper kettle, but afterwards permit it to be precipitated as a scarlet biniodide by a solution of iodide of potassium? I wish to print it upon cotton-cloth, using the same *modus operandi* as calico printing. I find that the copper colour-kettles and printing-rollers decompose it, in consequence of the mercury uniting with the copper. The effect is not satisfactory if I use the solution of iodide of potassium as a mordant. How can I prevent the chloride solution from being decomposed?—William.

TO CORRESPONDENTS.

*** The Students' Number of the Chemical News will be published on Friday, September 17th. Gentlemen holding official positions in the Universities, Medical Schools, &c., of the United Kingdom, where Chemistry and Physical Science form a part of the Education, who have not yet forwarded the necessary information to our office for publication in that number, will confer a favour by sending it with the least possible delay.

BOOKS RECEIVED.

Recent Discussions on the Abolition of Patents for Inventions in the United Kingdom, France, Germany, and the Netherlands. London: Longmans, Green, and Co.

Chemical Manufacturers' Plant. By Robert Daglish and Co. Lancashire: St. Helen's Foundry.

On Fresh Meat Preservation. By John Gamgee. London: Robert Hardwicke.

THE CHEMICAL NEWS.

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ON THE

DETECTION OF FIXED OILS IN PLANTS.*

By T. T. P. BRUCE WARREN.

THE object of this communication was to point out a simple method applicable, on a small scale, to the determination of oils in vegetable juices, &c.

To juice containing caoutchouc, hydrochloric acid is first added, to coagulate it. The residue is treated with bisulphide of carbon, which dissolves out the oily and fatty matter. The addition of dichloride of sulphur causes a granular precipitation in the clear decanted solution.

Fibrous substances are preferably treated with rectified ether, and the caoutchouc, if present, removed by the addition of alcohol, before digesting in bisulphide of carbon.

ON THE

PRESENCE OF SOLUBLE PHOSPHATES IN SEEDS.†

By F. CRACE CALVERT, Ph.D., F.R.S.

SOLUBLE PHOSPHATES IN COTTON PODS.

SOME results which I had obtained on the presence of the acid phosphate of magnesia in cotton-fibre, and which I had the honour to lay before the Chemical Society some time since, induced me to continue these researches with a view of ascertaining if the same phosphate existed in the other portions of the cotton pod, viz., the husk and the seed, and, if not, whether the phosphoric acid existing in the same was combined with other bases. It will be, no doubt, also remembered that I found that the mean quantity of acid phosphate of magnesia, $2MgO,HO,PO_5$, in ten samples of cotton fibre which had been imported from various parts of the globe, was equal to 0·05 per cent PO_5, or 0·084 $2MgO,HO,PO_5$.

But, before examining the nature and amount of phosphates present in the husk and seeds constituting the cotton pod, I deemed it advisable to repeat my former experiments, and to confirm them by separating the cotton fibre from the same pods from which I intended to submit the husks and seeds to analysis, and I am glad to say that I obtained results confirming entirely the previous ones, viz., that 100 parts of cotton fibre yielded, when repeatedly washed with water, a quantity of acid phosphate of magnesia = 0·084 of acid phosphate of magnesia, or 0·050 of phosphoric acid, and, further, as in my previous results, only a trace of potash and lime were found in solution, and that no other salts of magnesia existed in solution.

HUSKS.

To ascertain if the amount and nature of the phosphates in the husks of the cotton pods were the same as in the fibre, 14·45 grms. of husks were reduced to fine powder, and steeped for twelve hours with 250 grms. of distilled water. This operation was repeated four times each, and the whole of the washings were filtered off, evaporated to dryness, and the residue calcined, and the following results were obtained on the analysis of the ash:—Only a small quantity of magnesia and lime was detected, nearly the whole of the phosphoric acid being combined with potash and with oxide of iron. The following results being obtained—

One hundred parts of husk gave—

Phosphate of potash, 0·531 = 0·178 PO_5, combined with potash.
Phosphate of iron, 0·227 = 0·106 PO_5, combined with sesquioxide of iron.
Phosphate of lime, 0·030 = 0·016 only PO_5, combined with lime.
And a trace of magnesia.

Therefore the phosphoric acid in the husk is not combined with magnesia, as in the fibre, but with potash and oxide of iron, and the total amount of phosphoric acid, instead of being 0·050, as in the cotton fibre, is 0·300, or six times as large.

SEED.

I now proceeded to determine the composition and amount of phosphates in this portion of the cotton pod, and obtained the following results:—

0·650 of phosphate of potash = PO_5, 0·217
0·117 of phosphate of magnesia = PO_5, 0·069
0·025 of phosphate of iron .. = PO_5, 0·011

These results, which are the mean of two analyses, as in the previous cases, show that the phosphates exist in much larger quantity in the seed than in the other parts of the pod—being, in fact, about sixteen times as large as in the fibre, and between three and four times that found in the husk.

Thus the quantity of phosphoric acid and phosphate existing in the various parts of the cotton pod are—

	PO_5.
Husk	0·300
Fibre	0·050
Seeds	1·092

The above results reveal two important facts—viz., that phosphates of potash, magnesia, and iron predominate in seeds, and not the phosphate of lime, as it was generally admitted; also that the nature and amount of the phosphates vary with each part of the said pod.

Further, it will be observed, that, in the husk, the phosphates of iron and potash predominate; in the fibre, phosphate of magnesia; and in the seed, phosphates of potash and magnesia. And what increases the interest is that nearly the whole of the bases existing in the cotton pod are combined with phosphoric acid.

THE AMOUNT OF SOLUBLE AND INSOLUBLE PHOSPHATES IN WHEAT SEED.

English White Soft Wheat.—220·8 grms. of very carefully picked and cleaned white wheat, dried at 230° F., were repeatedly washed with distilled water, and the washings evaporated, and the residue calcined, when only—

0·010 of residue was left, thus showing that water had little or no action upon the grain when acted upon in such a condition.

I therefore decided to act on the same grain when crushed, so that water could penetrate into the mass, and dissolve all soluble salts; but, before doing so, I deemed it advisable to determine the total amount of phosphoric acid existing in the wheat operated upon, and obtained, in one analysis, 0·633 per cent of phosphoric acid, and, in a second analysis, 0·677 per cent, or 55·5 on 100 parts of ash.

These results clearly show, as Fresenius has done before me, that nearly the total of the ashes left by wheat is represented by phosphates.

With a view of ascertaining what amount of these phosphates would be dissolved by water in crushed wheat, 50 grms. of white, crushed soft wheat, dried at 230° F., were placed in a bottle with 150 grms. of distilled water, mixed with a little carbolic acid, so as to prevent any fermentation, or the production of any acid. After twenty-four hours, the aqueous solution was removed, and a fresh quantity of distilled water added; and these washings were repeated until all mineral matter was dissolved, the whole of the washings were evaporated, and the residue calcined. The amount of phosphoric acid determined

* Abstract of a paper read before the British Association, Exeter meeting, Section A.

† Read before the British Association, Exeter meeting, Section B.

was equal to 0·394; therefore nearly two-thirds of the phosphoric acid or phosphates existing in wheat are soluble in water.

English Red or Hard Wheat.—I deemed it advisable to determine the total amount of phosphates and of soluble phosphates in red or hard wheat, as I had done in soft or white wheat, and thus found that 100 parts of red hard wheat, dried at 230° F., yielded 0·749 phosphoric acid; and that 100 parts of the same, when dried at 230° F., and crushed, yielded 0·376 of soluble phosphates.

I regret that I had not the opportunity of repeating these results on white and hard wheats obtained from various countries, or cultivated on different classes of soils, viz., clay, lime, or sand formations, as the phosphates are in larger proportion in red wheat than in soft, and that half the phosphates are soluble in the red wheat and two-thirds in the white soft wheat, and therefore I cannot, under these circumstances, assume that the difference in amount of the phosphates is due to the nature of the wheat, and not to the soil.

These results led me to enquire if the various parts which constitute the grain of wheat contain the same amount and nature of phosphates when separated by the successive and different operations carried out by a miller.

The results of my experiments, as it will be seen, have fully answered my expectations—viz., the phosphates in each section of the cortical parts of the grain do not so much vary in their nature as they do in quantity: their amount decreases gradually from the outer sections towards the central ones; thus, whilst the flour contains only a trace of phosphates, especially soluble ones, the bran contains a large quantity.

The total amount of phosphoric acid in—

Bran	1·682
Flour	0·971

Soluble phosphates—

Bran	1·264
Flour	0·080

A large miller in the neighbourhood of this city having kindly consented to grind and bolt a few sacks of wheat, to enable me to obtain in a separated state the various parts constituting the grain, and placed in my hands the five distinct specimens, as representing in a rough way those various layers presented by a grain of wheat.

No. 1. Coarse bran.
No. 2. Coarse bran.
No. 3. Coarse sharps.
No. 4. Fine sharps.
No. 5. Flour.

AMOUNT OF PHOSPHORIC ACID AND PHOSPHATES IN THE VARIOUS PARTS OF WHEAT.

	Corn and bran.	II.	III.	IV.	Flour.
Phosphoric acid combined with sesquioxide of iron	0·042	0·047	0·037	0·015	0·022
Phosphoric acid combined with magnesia and a small quantity of CaO	1·485	1·259	0·657	0·329	0·047 0·144
Phosphoric acid combined with potash	1·071	1·046	0·459	0·280	0·758
Total—	2·598	2·352	1·153	0·624	0·971
Phosphate soluble in water	1·942	1·666	0·918	0·529	0·080

These facts also tend to show that most of the phosphates contained in wheat are not combined with the organic matter, but are in a free condition.

Further, that the greatest part of the phosphates are soluble, and combined with potash and magnesia, whilst the insoluble phosphates are represented by lime, iron, with a small proportion of MgO, the latter salt being probably neutral phosphate of magnesia, $3MgO,PO_5$, whilst the salt of MgO in solution is $2MgO,HO,PO_5$; and what tends to support this view is that, although the same weights of bran were washed with the same quantities of water, and for the same space of time, the quantities of phosphates of magnesia decrease rapidly in each successive layer of the seed as we proceed from its external part towards its interior.

Also that, whilst in No. 1 bran only one-fifth of the phosphates are retained as insoluble, in No. 4 one-sixth remains in an insoluble condition.

These analyses clearly illustrate that, although habit and pride have gradually led us to prefer white bread to brown, or more so bread made with nearly the whole of the constituents of wheat grain, still this practice is an error when we consider the nutritious properties of wheat, especially as a food for children, when phosphates are so essential to the formation of bone and blood; and medical men would confer a great boon on society if they were to impress the importance of feeding children with a wheaten preparation in which all the constituents of the grain were preserved.

These views are further supported by some very interesting researches published in the *Comptes Rendus* by M. Mège Morries, in which he proved that there was, in the inner cortical parts of the wheat, a special ferment, which converted most rapidly starch into sugar, and thereby facilitated the conversion of wheaten flour into bread.

These observations of M. Morries led him to devise a peculiar mode of grinding wheat, and making bread from the flour thus obtained, and the results were such that, from every hundredweight of wheat, he was enabled to obtain of bread—

Wheat, 100.

Ordinary process ..	70 flour ..	92 bread
M. Morries	82 „ ..	110 „

This method was so satisfactorily carried out that the Emperor of the French adopted it at the military bakery of Paris, in which bread is baked every day for 100,000 men.

In conclusion, I may be permitted to state that I am aware of the analyses of wheat which have been made by Professor Way and Dr. Voelcker, and especially of those remarkable and extensive researches published by G. B. Lawes, F.R.S., and G. H. Gilbert, F.R.S., "On the Composition of the Ash of Wheat Grain," and, by the last-named gentleman, "On Wheat Grain and its Product in the Mill." But the researches of these gentlemen only give the total amount of phosphoric acid in these products, but do not give, as I have attempted to do, the respective various proportions of phosphates of potash, magnesia, lime, and iron which exist in the various parts of wheat grain.

ON THE PHOSPHORESCENCE OF THE SEA, AND ON OZONE IN CONNECTION WITH ATMOSPHERIC CONDITIONS.*

By J. MOFFAT, M.D., F.R.A.S., F.G.S., &c.

As it appears from results deduced from observations taken at sea, that ozone periods (as on land) commence, and that ozone is in maximum quantity with decreasing readings of the barometer and the conditions of the south or equatorial current of the atmosphere, and that ozone periods terminate with increasing readings of the barometer and the setting in of the polar current, and that phosphorus is luminous and non-luminous under similar conditions, I supposed that there might be some con-

* Read before the British Association, Exeter Meeting, Section B.

nection between ozone and the phosphorescence of the sea.

Observations are still taken, and I hope to be able to give results from a larger area. The following are deduced from observations taken between latitudes 58° and 79° N., and longitudes 6° E. and 67° W. :—

TABLE I.

Shewing the Amount of Ozone with (at Sea)—

BAROMETER.		DIRECTIONS OF THE WIND.				PHOSPHORESCENCE.	
Increasing.	Decreasing.	N. to E.	S.E.	S. to W.	N.W.	None.	Brilliant.
2·9	4·7	1·6	2·7	3·7	3·2	2·4	3·0

TABLE II.

Shewing the Mean Reading of the Barometer, Mean Temperature, and Daily Mean of Ozone at the Commencement and Termination of Phosphorescence of the Sea, between latitudes 58° and 79° N., and longitudes 6° E. and 67° W.

Phosphorescence.	Barometer.	Thermometer.	Ozone.
Commencement of	29·46	34·8	2·9
Termination of	29·65	30·0	1·5

TABLE III.

Shewing Mean of the Barometer and Thermomcter, and the Daily Mean of Ozone, with Commencement and Termination of Periods of Luminosity of Phosphorus, deduced from the Observations of Six Years (on Land).

Periods of Luminosity of Phosphorus.	Mean of Barometer.	Mean of Thermometer.	Mean of Ozone.
Commencement	29·640	47·3	5·0
Termination	29·734	43·4	3·0

By these results, it appears that the phosphorescence of the sea and luminosity of phosphorus occur under similar atmospheric conditions.

The amount of ozone the day before phosphorescence			0·8
,,	,,	day of	,, 2·5
,,	,,	day after	,, 1·9

Of auroral displays, one was without ozone, and 50 per cent were accompanied by phosphorescence.

A FEW REMARKS ON THE

REDUCED OR PRECIPITATED PHOSPHATE OCCURRING IN SUPERPHOSPHATES.

By ALFRED SIBSON, F.C.S.

THE fact of superphosphate "going back," or losing in soluble phosphate, on keeping, will hardly at present be disputed, the question at issue being whether the phosphate so reduced can be estimated or not.

It often happens that a quantity of superphosphate, which, when freshly made, contains, say, 25 per cent of soluble phosphate, is found, after keeping (in some cases only a short time), to have lost 2, 3, 5, or even more, per cent of its soluble phosphate; in fact, the paper of Mr. Sutton, which appeared two or three week's since, and which, although averse to the above question, the superphosphate operated on is stated to have contained, originally, 23 per cent, while it then had only 17 to 18 per cent, or a loss of 5½ per cent. Instances of this kind are, however, familiar to all who have had much to do with this class of manures.

As it is, also, found impossible by the manufacturer to calculate upon the extent of this retrogression, it is a constant source of dispute between buyer and seller, and also tends to bring discredit on analysis, as there is no apparent reason why a superphosphate should contain less soluble phosphate at one time than it did at an earlier period; in fact, the contrary would naturally be expected from the concentration of the bulk through the loss of moisture.

There thus appears an urgent necessity for some means of determining the phosphate so reduced; and if a scientifically-accurate method be not forthcoming, it appears to me only reasonable to be satisfied, under the circumstances, with some method which, for all practical purposes, gives comparative and reliable results; such a method I have found to be the following:—

The point is to find some reagent which does not affect the undecomposed coprolite (that being the mineral now more especially considered). I soon found that dilute acids, including acetic, citric, and oxalic (this least so), were objectionable on this account, and was led to try oxalate of ammonia, which, as a perfectly neutral salt, would be altogether unlikely to decompose a perfectly mineralised substance like coprolite. As well known, the decomposition of gelatinous phosphate of lime by oxalate of ammonia is a quantitative reaction, which takes place at once, the only necessity for boiling being to assist the subsequent filtration. Boiling for ten minutes at the most is sufficient to effect this object, while the oxalate does not, under these circumstances, attack the coprolite to any material extent. I am aware this statement is somewhat at variance with the results of other contributors which have lately appeared, but, as the process they state differs from that I have adopted, the different results may, perhaps, be accounted for. I have no intention, however, of entering into a controversy on this subject, but give the full particulars of the process, so that any one interested in the matter can try it for himself. I have since found that oxalate of ammonia had been suggested by others for this purpose, but was unaware of the fact when I selected it.

25 grains of Cambridge coprolite are boiled, with an equal weight of oxalate of ammonia, in 2 ounces of water, for ten minutes, and filtered; the filtrate acidified with hydrochloric acid, and made alkaline with ammonia (merely to ensure the presence of chloride of ammonium); and ammoniacal sulphate of magnesia added. No precipitate will probably be obtained; but, *if it be obtained*, it is not conclusive of the presence of phosphoric acid; and great errors may be made if a precipitate in this place be accepted as phosphate of magnesia and ammonia. After standing for two hours, the small precipitate is collected (which often resembles the phosphate closely, but consists of oxalate of magnesia, which sometimes separates from a concentrated solution, and a little oxide of iron) and re-dissolved in hydrochloric acid, citric acid added, and re-precipitated with ammonia. A precipitate, if now obtained, consists of phosphate of magnesia and ammonia only, and if burned and weighed as phosphate of magnesia in the usual way, will be found to amount to less than 0·50 per cent, calculated as bone-earth. This was found to be the case with coprolite ground as fine as it is possible to get it for analysis; but I have just been through the process again with coprolite in the state usually employed by manufacturers, and find no weighable quantity of phosphate of magnesia after standing three hours. I thus consider that 0·50 per cent of phosphate of lime is the utmost error that can be made by this process under proper management.

In the case of a superphosphate containing reduced phosphate, and treated as above, after having first extracted the soluble phosphate, by cold water, the phosphate of magnesia calculated as bone-earth will represent the phosphate so reduced.

I am aware of the new process, suggested by Mr. Chesshire, and adopted by the chemists for the plaintiff (with the exception of myself) in the late trial at Gloucester, referred to by that gentleman, and have, therefore, every confidence in its value, but have not yet satisfied myself whether it is superior to the plan I have hitherto adopted as above described.

I need scarcely add that it is not my intention to introduce the determination of precipitated phosphate into my ordinary analysis of superphosphate, nor include it in the

usual determination of soluble phosphates, but only give it when especially requested, and state it separately; since, whatever its agricultural value may be (space forbids my entering upon this part of the question), it is no longer soluble phosphate, and will not obviously pass as such when a definite percentage of soluble is bargained for; its value is, however, at the same time very superior, I consider, to undecomposed, or ordinary insoluble phosphates.

There is one objection to the introduction of this constituent into the ordinary analysis of manures—viz., that it would be likely to lead to greater discrepancies than occur at present, and which, I believe, are caused far more by a want of sufficient attention and method in the details of the analysis on the part of the operator than by any defects in the method of analysis.

Finally, as regards the ordinary determination of soluble phosphates in superphosphates, I find the method of precipitation perfectly satisfactory and consistent when carefully performed, and believe it to be by far the best method; while, in point of time, it leaves nothing to be desired under proper management. I gave much attention to the uranium process some time since, but did not find it satisfactory in the case of superphosphates made from a mixture of phosphates.

ON

SOME DERIVATIVES OF TRICHLORMETHYL-SULPHON-CHLORIDE.

By O. LOEW,

Assistant in the Chemical Department of the College of the City of New York.

This chloride, discovered by Berzelius and Marcet in 1812, was the subject of extended investigations by Kolbe. Since that time, no investigations on this compound have been made, although it possesses many interesting properties. I find that the simplest way to prepare it is the following:—300 grms. of bichromate of potassium, in pieces the size of a pea, 500 grms. of common hydrochloric acid, 200 grms. of nitric acid of the common strength, and 30 grms. of bisulphide of carbon, are mixed in a flask, filling it to one-fourth of its capacity, and loosely stoppered. It is kept cool in the beginning, and shaken from time to time. In about eight days the process is finished; in direct sunlight, only four days are required. By addition of water, the chloride and nitrate of potassium are dissolved, and there remains the insoluble trichlormethyl-sulphon-chloride. It is filtered off, washed, and pressed between sheets of filter-paper.

When this chloride is dissolved in absolute alcohol, and treated with sulphuretted hydrogen, sulphur is deposited, and hydrochloric acid and another compound of an acid character remain in solution. By neutralisation with dry carbonate of sodium, the sodium-salt of this new acid remains dissolved in the alcohol, and crystallises by evaporation in shining scales.

0·469 grm. yielded 0·146 grm. of sulphate of sodium = 11·33 per cent Na.

0·236 grm. yielded 0·490 grm. AgCl = 51·37 per cent Cl.

0·511 grm. yielded 0·605 grm. of sulphate of barium = 16·24 per cent S.

The sodium-salt of the trichlormethyl-sulphurous acid requires—11·14 per cent Na; 51·95 per cent Cl; 15·56 per cent S; 15·56 per cent O; 5·81 per cent C.

To obtain the free trichlormethyl-sulphurous acid, the sodium-salt is decomposed by dilute hydrochloric acid and agitated with ether. The ether yields, by evaporation, this new acid in radiating needles. Both the acid and its salts are not of great stability; at a moderate temperature, especially when water is present, decomposition takes place, and a very offensive odour is evolved.

The formation of this acid takes place according to the following equation:—

$$\underbrace{(CCl_3)SO_2Cl}^{\text{Trichlormethyl-sulphon-chloride.}}{}^{*} + H_2S = \underbrace{(CCl_3)SOOH}_{\text{Trichlormethyl-sulphurous acid.}} + HCl + S.$$

The decomposition of this acid and its salts, by bromine and nitric acid, is very striking; the acid disappears, and new insoluble compounds are formed.

The action of bromine is expressed by the following equation:—

$$\underbrace{(CCl_3)SOOH}_{\text{Trichlormethyl-sulphurous acid.}} + Br_2 = \underbrace{(CCl_3)SO_2Br}_{\text{Trichlormethyl-sulphon-bromide.}} + HBr.$$

And the action of nitric acid—

$$\underbrace{(CCl_3)SOOH}_{\text{Trichlormethyl-sulphurous acid.}} + \underbrace{NO_3H}_{\text{Nitric acid.}} = \underbrace{(CCl_3)SO_2(NO_2)}_{\text{Trichlormethyl-sulphon-nitride.}} + H_2O.$$

The trichlormethyl-sulphon-bromide is a white crystalline body of a faint acrid smell, insoluble in water but soluble in alcohol and ether. On the application of heat a part is sublimed without change, while another part is decomposed. Ammonia dissolves it with evolution of nitrogen.

0·358 grm. yielded 0·313 sulphate of barium, corresponding to 12·01 per cent S.

0·492 grm. yielded 1·158 grms. AgCl + AgBr, and this mixture yielded, by reduction, 0·808 Ag, which proportions correspond to 30·77 per cent Br, and 40·22 per cent Cl.

The theory demands 12·19 per cent S, 40·57 per cent Cl, 30·48 per cent Br.

When trichlormethyl-sulphurous acid is brought into contact with concentrated nitric acid, a violent reaction takes place, and a blue oil is deposited which loses nitrous acid by contact with the air, and is converted into a white crystalline body, the odour of which inflames the eyes and is very suffocating when inhaled. This is the trichlormethyl-sulphon-nitride, especially interesting in this, that a nitride of an organic sulph-acid has been hitherto unknown. It is insoluble in water, soluble in ether and alcohol. Water added to the alcoholic solution precipitates it unchanged. It does not melt in boiling water, but is volatilised with the steam. Ammonia dissolves it slowly, with decomposition: alcoholic solution of caustic potassa decomposes it quickly. When it is treated with zinc and hydrochloric acid, it disappears, and is converted into sulphydrate of methyl and ammonia—

$$\underbrace{(CCl_3)SO_2(NO_2)}_{\text{Trichlormethyl-sulphon-nitride.}} + 18H = \underbrace{CH_3SH}_{\text{Sulphydrate of methyl.}} + H_4NCl + 2HCl + 4H_2O$$

0·5285 grm. yielded 0·532 sulphate of barium and 0·973 AgCl, corresponding to 13·83 per cent S and 46·12 per cent Cl.

Theory demands 14·00 per cent S and 46·61 per cent Cl.

On treating trichlormethyl-sulphon-chloride with ammonia, trichlormethyl-sulphurous acid is formed in an unexpected manner, nitrogen is evolved, and the chloride is slowly dissolved. On evaporation, broad tabular crystals are obtained. In the mother liquor, there remains chloride of ammonium, some sulphate of ammonium, and a certain quantity of this new compound. The crystals must be re-crystallised with great care, because, at a moderate temperature, an acid reaction sets in and a partial decomposition begins. These crystals show, with bromine, as well as with nitric acid, the formation of the above-mentioned bromide and nitride. The action of the nitric acid is extremely violent.

By mixing with diluted hydrochloric acid, and agitating with ether, the above-mentioned trichlormethyl-sulphurous acid is obtained.

* C=12 S=32 O=16.

0·431 grm. yielded 0·911 grm. AgCl = 52·24 per cent Cl.
0·668 grm. yielded 0·725 ammonio-chloride of platinum = 6·80 per cent N.
0·753 grm. yielded 0·894 grm. sulphate of barium = 16·23 per cent S.
Theory demands 53·11 per cent Cl, 6·98 per cent N, 15·96 per cent S.

The crystals are, therefore, the ammonium salt of the trichlormethyl-sulphurous acid, and their formation can be expressed by the following equation :—

$$\underbrace{3[(CCl_3)SO_2Cl]}_{\text{Trichlormethyl-sulphon-chloride.}} + 8H_3N = \underbrace{3[(CCl_3)SO_2H_4N]}_{\text{Trichlormethyl-sulphite of ammonium.}} + 2N + 3H_4NCl$$

On treating trichlormethyl-sulphon-chloride with cyanide of potassium, evolution of cyanogen and hydrocyanic acid takes place, and the potassium salt of trichlormethyl-sulphurous acid is formed—

$$(CCl_3)SO_2Cl + 2KCy = (CCl_3)SOOK + KCl + 2Cy.$$

But, when the solution is hot and very concentrated, there is, also, another derivative of this acid formed, one atom of Cl being replaced by one atom of OH—

$$(CCl_3)SOOK + H_2O = (CCl_2OH)SOOK + HCl,$$

which latter decomposes another part of the cyanide of potassium.

A glance at the following formulæ will show the relation between these new bodies and several others already known :—

Trichlormethyl-sulphon-chloride $(CCl_3)SO_2Cl$ (Kolbe).
Trichlormethyl-sulphon-bromide $(CCl_3)SO_2Br$.
Trichlormethyl-sulphon-nitride $(CCl_3)SO_2(NO_2)$.

Trichlormethyl-sulphur*ic* acid $(CCl_3)SO_2OH$ (Kolbe).
Trichlormethyl-sulphur*ous* acid $(CCl_3)SOOH$.
Methylsulphur*ic* acid $(CH_3)SO_2OH$ (Kolbe).
Methyl-sulphur*ous* acid $(CH_3)SOOH$ (Hobson).

—*American Journal of Science.*

ARTIFICIAL PRODUCTION OF ICE.

By P. H. VANDER WEYDE, M.D.

CALCULATION OF THE AMOUNT WHICH CAN BE PRODUCED FROM A GIVEN AMOUNT OF COAL IN THE MODERN ICE MACHINE.

THE amount of ice produced by an ice machine, worked by means of an exhaust or condensing air-pump, driven by steam power, is easily determined, theoretically, from the amount of coal burned in the furnace of the steam boiler. It has been proved that the combustion of one pound of anthracite coal produces, in round numbers, 14,000 units of heat, and that in order to freeze water of 72° Fahr., it is necessary to abstract, besides 40° of sensible heat, 140° of latent heat—together 180°—which, for one pound of water is, of course, equivalent to 180 units of heat. As this number of the units is the eightieth part of the 14,000 units produced by the combustion of one pound of coal, it is clear that the heat produced by the combustion of one ton of coal is equivalent to the heat to be abstracted from 80 tons of water of 72°, in order to change it into ice.

But in practice we find here exactly the same state of affairs as is the case with the steam engine. Theoretically, a steam engine ought to produce at least 700 units of force (foot-pounds) for every unit of heat consumed; in practice, good machinery only produces from about 70 to 100 foot-pounds, from about one-tenth to one-seventh part of the theoretical amount. In the best ice machines thus far constructed, instead of freezing 80 tons of water, for every ton of coal consumed, only from about 8 to 11 tons of ice are produced, also, from one-tenth to one-seventh part of the theoretical amount, proving, thus, the remarkable fact, that in both the steam engine and the ice machine, exactly the same relation exists between the theoretically calculated effects and the practical results.

As, however, all the best ice machines accomplish the conversion of the heat of the fuel into the freezing operation by the intervention of a steam engine, the fact that they practically produce only from one-tenth to one-seventh of the amount of the cold they theoretically should produce, is solely due to the other fact, that the steam engine itself practically produces only from one-tenth to one-seventh of the amount of power which would be strictly equivalent to the number of heat units consumed. It must not be lost sight of that it is only the power of the steam engine which generates the cold in the freezing machines, and that, therefore, improvements in the steam engine, which bring its practical results nearer to the theoretical standard, will at once exert their influence on the amount of ice the ice machines can produce, and, consequently, also on the cost of the ice manufactured in these machines.

Moreover, it appears that the kind of freezing machines in question, which convert power into cold, notwithstanding they are yet in their infancy, have already attained such a degree of excellence, that they are ahead of that class of machines which convert heat into power, either by steam, hot air, or any other possible means, as it is proved that they produce the full theoretical equivalent of cold (negative heat) for the number of foot-pounds employed; namely, cooling one pound of water one degree for a power equivalent to 700 pounds, descending one foot, which, expressed in the adopted scientific manner, is one unit of negative heat for every 700 foot-pounds consumed.—*Scientific American.*

ON A

NEW SOURCE OF THE FIRST TERMS OF THE FATTY ACIDS,

AMONGST OTHERS OF PROPIONIC ACID.

By M. BARRB.

THE dry distillation of wood produces a very acid liquid, from which acetic acid is extracted in large quantities. The general mode of purifying the latter is to saturate the liquid with carbonate of soda, when concentration produces crystallised acetate of soda and mother liquors. These latter diffuse a strong smell of molasses. When a certain degree of concentration has been reached, the crystals cease to form, and, if evaporation be continued, they assume a confused and hygrometric mass. This latter has been the subject of my experiments. On treatment with sulphuric acid, it decomposed, forming two liquid films, which were mingled into one by the addition of water. Instead of separating these acids by fractional distillation, I operated upon their ethers, first separating them into volatile portions—

I.	Between	55°	and	58°.
II.	,,	74°	,,	77°.
III.	,,	95°	,,	98°.
IV.	,,	114°	,,	119°.
V.	,,	133°	,,	136°.
VI.	,,	162°	,,	165°.

and then saponifying with baryta.

I. The baryta salt produced by the ether boiling at 55° or 58°, being heated with monohydrated sulphuric acid, disengaged pure oxide of carbon. This salt reduced nitrate of silver at the boiling point; formed with perchloride of mercury a white precipitate of protochloride, &c.; and it presented the crystallographic characteristics of formiate of baryta. The ether produced was therefore nearly pure ethylformic ether.

II. The baryta salt No. 2 was acetate, as might be foreseen.

III. Baryta salt No. 3, after purification by successive crystallisations, assumed the form of perfectly defined oblique prisms. The dry salt remained unaltered in the air. Its solution, left in contact with the atmosphere, evolved a slight odour, which proved the commencement of decomposition. When dried at 100°, it decomposed slowly, losing its water of crystallisation, and changed into a salt insoluble in water. It was impossible to obtain a sensibly-pure salt, except by evaporation at a very low temperature in a receiver whose atmosphere had been dried by sulphuric acid. Analysis gave 50·7 of baryta per cent of the salt. The propionate of baryta, according to the known formula, $C_6H_5BaO_4.HO$, contains 50·7 per cent of baryta.

The lead-salt, dried at 110°, yielded a syrupy, transparent, non-crystallisable mass.

IV. Baryta salt, No. 4, took the form of flattened prisms, melting below 100°. On analysis, it yielded 44·0 per cent of baryta; the butyrate of baryta, $C_8H_7BaO_4.2HO$, contains 44·6. This salt, when treated by chlorhydric acid and chloride of calcium, decomposes, and leaves a film of butyric acid floating on the surface of the liquid. Treated with a mixture of alcohol and sulphuric acid, it forms ethyl-butyric ether, having the characteristic smell of pine-apple.

V. Ether, No. 5, treated like the preceding, gives a salt which crystallises in thin flakes which effloresce quickly on contact with the air. The dry crystals, finely powdered and thrown into water, perform rapid gyrations.

When again dissolved in water and treated with sulphuric acid, an acid is formed, insoluble in water, distilling between 172° and 178°; this is valerianic acid.

VI. Baryta salt, No. 6, was crystallisable, but with difficulty. Its solution, treated with sulphuric acid, sets free a liquid acid lighter than water, but slightly soluble in the cold, soluble when warmed, soluble in every proportion in alcohol, distilling at from 198° to 205°. When saturated by a standard solution of caustic baryta, its equivalent was found to be 118·1, whilst that of caproic acid is 116. The difference of the equivalent is owing to the presence of a small quantity of acid boiling at a higher temperature, which hinders the crystallisation of the caproate.

On examining the relative proportions of these acids, formic acid is found to occur in small quantities only. Acetic acid is most abundant, the relative proportion of each diminishing as it rises in the series.

Propionic acid, whose soda-salt is very soluble in water, is found thus concentrated in the preparation of acetate of soda. The mother liquors, which contain a large quantity, might become an abundant source of its production, which has hitherto been attended with difficulty. The transformation of soda-salt into ethylic ether allows of complete purification.

This series of homologous bodies produced by a single reaction is dependent upon a general law in organic chemistry, that of simultaneous production; either in the order of analysis, the homologous bodies being produced by successive divisions, or in the order of synthesis, being formed inversely by successive additions.—*Comptes Rendus*, vol. lxviii., p. 1222.

Non-Poisonous Colours.—We have received two samples from Mr. F. Pettit, viz., yellow zinc and green zinc; and, after having tested them we are satisfied that the statements made by the makers of these colours are correct. Of the beautiful yellow and green pigments we have had the opportunity of testing, we affirm with pleasure that (1) they are not poisonous; (2) they do not become discoloured by the effects of burning gas; (3) they are not affected by sulphuretted hydrogen gas, and are not altered in shade—as far especially as the green is concerned—by artificial light. For paper-stainers, the manufacture of surface-coloured paper, for mixing with plaster-of-Paris for ornamental stucco work on walls, these colours will answer well, as they also will for mixing oil pigments, while, for pigment cotton printing, chromo-typography, and lithography, they will supply colours of great brilliancy, durability, and quite sufficient body.

ON A NEW REACTION OF PHENOL.

By C. CRUMP.

If fragments of caustic potash be added to a solution of phenol in chloroform, the potash becomes covered with a rose-coloured coat, which gradually dissolves in the liquid. Considerable heat is produced, and the action goes on rapidly until the mixture which at first was red has become brown and thick. It then slackens, but may be renewed by a gentle heat, until potash has been added equal in quantity to about three times the weight of the phenol.

The final product of the reaction is a brown amorphous mass, soluble in alkaline liquids, and precipitated therefrom by acids. It seems to be a mixture of two substances, differing in solubility in alkalies and in their behaviour with strong sulphuric acid.

The first substance dissolves very easily in carbonate of potash or soda, less readily in strong sulphuric acid. From the latter solution a precipitate is thrown down by water, which behaves with alkalies like rosolic acid.

The second substance dissolves less freely in alkalies, very easily in strong sulphuric acid, forming a brown liquid from which nothing is precipitated on dilution. With tetrachloride of carbon instead of chloroform no action takes place in the cold; at 100° C. the liquid assumes the colour of rosolic acid.

When creosote from wood-tar is treated with chloroform and caustic potash, a reaction takes place very similar to that with phenol, but the product of the reaction is quite different, forming with sulphuric acid a deep crimson solution, from which a dingy green precipitate is thrown down by dilution. Moreover, the substances produced from phenol in alkaline solution colour silk or wool brown, while those from creosote have no colouring power.

NOTICES OF BOOKS.

Alkali Act, 1863; *Fifth Annual Report by the Inspector of His Proceedings during the year* 1868. Presented to both Houses of Parliament. 1869. Eyre and Spottiswoode.

It will be in the memory of all of us that, in 1863, Lord Derby brought in a bill for the removal of the nuisance caused by alkali works. It had long been noticed that, in the neighbourhood of such works, no kind of vegetation could flourish; and other evils were found to result. It was hence proposed that means should be adopted for preventing the escape of hydrochloric acid into the air, and that an Inspector should be appointed to see that the enactments of the bill were properly carried out. Inasmuch as the bill was entirely free from any party influence, it rapidly received the assent of both sides of both Houses, and became law somewhat more than five years ago. Dr. Angus Smith was appointed Inspector, and he has annually issued a report, that which we are about to notice being the fifth.

In the report for 1867, the escape from the hydrochloric acid condensers was stated to be under 1 per cent, while 2 per cent was allowed for leakages through the brickwork. No diminution of this amount can be shown for the succeeding year, although, in the case of "open-furnace works," the escape is much smaller, and is considered to be not more than 0·5 per cent, leakage included. Various new furnaces have, however, been constructed, and it is confidently expected that the escape may ultimately be reduced to almost a vanishing quantity.

From page 6 to page 22, the space is occupied by accounts of various alkali works, and the improvements effected during the year; and first in the case of works with open roasters:—

No. 53. To each condenser is connected a wash-tower

containing 400 cubic feet of condensing space. The escaping gases were found to be reduced in temperature 400° F. between the roaster and condensers; the acid obtained was of 19° Twaddle, and the escape was 0·9 per cent.

No. 115. These are new works, and consist of one decomposing pan, a pan condenser 60 feet high, containing 2,400 cubic feet of condensing space, and one roaster condenser with two shafts, each containing 1400 cubic feet. Charge, 6 cwts. per hour; escape, 1·9 per cent.

No. 68. The escape varied from 1 to 5 per cent.

Secondly, in the case of works with close roasters:—

No. 45. March 3.—Two pots with flanges and rims, and close furnaces are used. A large quantity of acid found in the flue. April 7.—A large quantity of acid found in flue. July 16.—A new furnace, constructed with great care, was set to work; but the results were unsatisfactory, and the escape large. Ultimately, after many trials, another new furnace was set to work, on November 12th, and the result was found to be satisfactory, and the escape of acid small. However this may be, the above results sufficiently indicate the advantage of the "open-furnace" system, unless there are certain drawbacks connected with it in reference to other matters than the provisions of the Alkali Act. The testing-glasses of Mr. Kane continue to work well, and to indicate with precision an undue escape of acid into the flues. The main difficulty appears to be to prevent leakage through the hot brickwork of the furnaces, since the amount of acid escaping with the smoke can be reduced by condensation to certainly 0·5 per cent, and, by lessening the velocity of the escaping current, to even less than this.

In regard to the matter of cooling flues, experiments have been made as to the relative cooling powers of brick and iron flues, with the following results:—

An underground brick flue cooled 7° F. per 10 feet.
An overhead brick flue cooled 18° per 10 feet.
An overhead cast-iron flue cooled 30° per 10 feet.

Thus the iron flues are most advantageous as regards cooling effect, but they are somewhat rapidly acted upon by the evolved gases, and do not last so long as brick flues. The following analyses show the composition of the deposit from cast flues in Mr. Mease's works. The "up pipe" was 65 feet from the furnace, and the temperature 468° F. The "down pipe" was 130 feet from the furnace, and the temperature 289° F.

Analysis of the Deposit in Cast-Iron Flues.

	Up pipe.	Down pipe.
Peroxide of iron	19·866	26·946
Alumina	3·171	4·614
Lime	0·371	0·486
Magnesia	0·414	0·298
Soda	11·311	2·808
Sulphuric acid	53·212	48·077
Chlorine	2·141	2·034

Water, loss, &c., in addition.

A number of estimations of the sulphur in coal have been made by Dr. Angus Smith and Mr. Fletcher. An examination of 70 specimens of South Lancashire coal by the former showed an average percentage of 1·1 of sulphur; while the examination of some specimens of St. Helen's coal by Mr. Fletcher showed a minimum of 0·6, and a maximum of 2·22, per cent of sulphur. If 300 cubic feet of air are used to burn 1 lb. of coal containing 2 per cent of sulphur, the amount of sulphurous acid in the smoke will be a little more than 1 grm. in a cubic metre, since that is equal to 35·318 cubic feet.

A number of very interesting analyses are given of the composition of coal-smoke (pp. 26 to 34), from which we extract the following:—

Chimney of a sugar refinery, 200 feet high. Smoke taken from a height of 30 feet from the ground. Speed of smoke, 12 feet per second. Internal diameter of the chimney at 30 feet from the ground, 10 feet. Amount of coal burnt per day, 35 tons.

	Black smoke.	Common brown smoke.
CO_2	6·64	4·26
CO	0·40	—
O	11·17	16·63
H	—	—
CH_4	0·02	—
C_nH_{2n}	—	—
N	81·77	79·11
	100·00	100·00

One hundred cubic feet of black smoke were found to contain, in addition to the above gases, 1047·44 grains of water, and 18·52 grains of soot.

It was considered very advisable that the condition of the air at some distance from alkali works should be known; and this, as regards its acidity, would be obviously best determined by examining the rain-water collected direct in porcelain vessels.

The maximum acidity (*calculated as sulphuric acid*) of rain which fell in Manchester in 1857 was 7·3960 grains per gallon, and the minimum 0·3169 grains per gallon.

Pendleton, Manchester. 1857.

Maximum acidity, 3·3810 grains per gallon.
Minimum „ 0·2641 „ „

Hulme, Manchester. 1857.

Maximum acidity, 2·5886 grains per gallon.
Minimum „ 1·3734 „ „

Rain; Manchester. 1868.

Maximum HCl, 1·2775 grains per gallon.
Minimum „ 0·0278 „ „
Maximum $HOSO_3$, 5·6000 „ „
Minimum „ 1·4000 „ „

The total acid in rain collected from various sources bears the following relationship:—

Row, Dumbartonshire	100·00	= 1
Whiston, ten miles from Liverpool	470·67	= 4⅔
Birkenhead	528·29	= 5¼
Liverpool	938·21	= 9⅓
Waterloo, on the shore	961·98	= 9½
Newcastle-on-Tyne	1054·73	= 10½
Manchester	1175·54	= 11⅔
Near an alkali work	1539·27	= 15⅓

We can scarcely be surprised, after glancing at this table, at the rapid decay of stone in certain localities, compared with others, and the long endurance of buildings of antiquity which are far from large towns, and in a pure and open air—such as the Parthenon, and the Pyramids of Egypt.

Some very interesting drawings are given by Dr. Angus Smith, on page 46, of the microscopic appearance of rain-water residues; and we are told that oxide of iron, sulphate of soda, phosphates, chloride of ammonium, and other substances may be readily detected in the rain of some localities. We are surprised to find that Dr. Smith has not examined any of the residues spectroscopically, as this would appear to offer the best means of detecting the minute traces of substances which are present; or is it that, in point of fact, almost every element would be detected by such an infinitely delicate test? Certainly, Bunsen has found that lithia is generally present in the air near the sea shore. According to M. Robinet (*Comptes Rendus*, 1863, p. 493), the Paris rain-water contains a substance which gives a garnet-red precipitate with nitrate of silver. In a summary of results obtained, Dr. Smith gives, among others, the following conclusions:—

"The rain from the sea (Western Islands) contains chiefly common salt, which crystallises clearly.

"The sulphates increase inland before large towns are reached.

"The sulphates rise very high in large towns, because of the amount of sulphur in the coal used, as well as decomposition.

"When the air has so much acid that two or three grains are found in a gallon of the rain-water, or forty parts in a million, there is no hope for vegetation in a climate such as we have in the northern parts of the country.

"Free acids are not found with certainty where combustion or manufactures are not the cause.

"Experiments in the direction indicated above may enable us to study and express in distinct language the character of a climate, and certainly of the influences of cities on the atmosphere."

In the Appendix to the Report will be found an interesting letter by Mr. A. E. Fletcher, "On the Speed of Air in Flues," as determined by the ether anemometer invented by himself, and described some time ago in this journal (vol. xvi., p. 141). The tables will be found of especial value: the one giving the corrections for temperature in a range of from 0° to 1000° F.; the other to show the conversion of the anemometer indications into the speed of the air current, with a range from 0·903 to 40·37 feet per second.

The report, as a whole, contains much valuable information, and is an important contribution to our knowledge of technology. Its range extends far beyond the more immediate subject of inquiry. The composition of the air of towns, as indicated by the solid residue of the rain, affects all of us, not alone as regards our health, but further, in relation to the preservation of our national monuments and public buildings. The comparison of the death-rate of various towns indicates the influence of impure airs upon the duration of our lives. Dr. Angus Smith has done much towards the examination of the influences of impure air and water upon mankind, and we hope he will continue his labours in the same fertile field.

CORRESPONDENCE.

IMPURITY OF INDIGO.

To the Editor of the Chemical News.

SIR,—Having been in the habit of experimenting on indigo, in order to arrive at a relative value of different samples, in order to rate the proper quantities for dyeing stated quantities of fabric, I was not under the necessity of examining the article for anything but its active colouring principles. But, a short time since, in making sulphate of indigo, I poured the solution from the dregs, and, throwing the sediment away, I kept the solution in a glass-stoppered bottle, exposed to strong light, and, at the end of a couple of months (not being at leisure to attend to this lot sooner), I found, on examination, that the contents of the bottle were almost solid, only about one-fifth of the whole being liquid.

I filtered the fluid portion from the solid, and obtained only a very small quantity of indigo carmine as result of examination, the solid mass being composed of a dirty-blue powder, which I washed away, being anxious to get at the principal matter in the mixture. After washing thoroughly, I obtained a heavy lot of fine, white needles, which had formed during the time that the solution was standing. Some blue spots adhering, I washed with dilute nitric acid, and then with water, obtaining the crystals tolerably clean.

I have consulted Watts's "Dictionary," and other works at my command, and, of all the reactions mentioned in connection with any of the salts of indigo, not one of them makes an impression on the mass.

Tested with SO_3, NO_5, HCl, and with aqua ammonia, sulphuric ether, alcohol, hot and cold water, also a solution of caustic potassa, none of which have any effect, as a drop on glass dries off without leaving a crystalline residue to show solution having taken place.

Heated to a cherry-red heat, the silky needles lose their pearly brilliancy, but still obstinately refuse to answer any of the reagents applied to them.

I have not applied hydrofluoric acid for fear of using all my stock of crystals up without arriving at a satisfactory solution, and have none left to send you.

I transmit herewith the balance of the crystals left in good order for your inspection, hoping you can throw some light on the compound.

The indigo from which these were obtained is an article known in the American market as "Madras" indigo, and, as this must indicate very extensive adulteration, I have ventured to trouble your patience with a history of it, in the hope that it may be of interest. If the subject is worth further efforts, I am ready to follow any suggestions as to the mode of procedure you may see fit to offer.

In conclusion, I will state that the SO_3 used to form the sulphate was bought as being chemically pure, but I did not test it; although, if it had been sophisticated with sulphate of soda, the result would not have been an insoluble compound, and, as the indigo was pounded fine in a mortar, and passed through a very fine sieve, the crystals could not have been in their present shape previous to the examination of the specimen.—I am, &c.,

NEW BERNE.

New Berne, N.C., U.S.A., July 27th, 1869.

[The substance of which our correspondent sent a sample proves to be soluble in boiling dilute hydrochloric acid. This solution yields a dense precipitate with chloride of barium, a flocculent precipitate with ammonia (alumina), and a strong precipitate with oxalate of ammonia. It is evidently a mixture of sulphate of alumina and sulphate of lime: other tests which have been applied confirm this statement. If the indigo had been ignited, our correspondent would have been able to judge of its quality from the quantity of ash. Good indigo leaves from 4·5 to 5·0 per cent of ash; but the less the better, of course. A mixture of pipe-clay and milk of lime is frequently used in the preparation of indigo; hence the phenomenon which puzzled "New Berne."—*Ed.* C. N.]

IMPROVED BUNSEN'S FILTER.

To the Editor of the Chemical News.

SIR,—Bunsen's filter being now in such general use, and such a necessary adjunct to a good laboratory, it seemed to me that any small improvements in connection with it could not fail to interest your readers.

In the place of the cone of platinum foil recommended by Bunsen, I now use a cone made either of platinum or copper gauze. When the fluid which passes through the filter does not act on copper, I prefer the latter. The cones are cut just as Bunsen describes, but can be fitted to the funnel direct, that is without the use of a matrix of plaster-of-Paris. This is accomplished by pressing the cone into the funnel to be used, with a piece of wood turned as nearly as possible to the proper angle. I may add that during the last three months, in which these cones have been in almost daily use, I find them to filter much quicker than the foil cones, and with quite as little risk of breaking the paper.—I am, &c.

R. S. DALE, B.A.

Cornbrook Chemical Works, Hulme, Manchester, September 8th, 1869.

London Gas.—It is stated that one hour after the gas of London is lighted the air is deoxidised as much as if 500,000 people had been added to its population. It is also stated that, by the burning of gas twenty-four hours in London, more water is produced than would supply a ship laden with emigrants on a voyage from England to Australia.

MISCELLANEOUS.

Professor Church, M.A.—The *Lancet* of August 28th, in noticing a report read at the Exeter meeting of the British Association, "On the Spectroscopic Examination of Animal Substances," refers to Professor Church's investigation of the red colouring matter of the wings of the turaco, and believes that Professor Church is the Assistant Physician to St. Bartholomew's Hospital. We have been requested to state that the investigator is not Dr. W. Church of St. Bartholomew's Hospital, but A. H. Church, M.A., Professor of Chemistry at the Royal Agricultural College, Cirencester.

New Chemistry Chair at Anderson's University.—A special meeting of the trustees of Anderson's University was held on Wednesday last for the purpose of considering the proposal of Mr. James Young, of Kelly, to found a chair of technical chemistry in connection with the University. Mr. Harvie was called to the chair. A letter was read from Mr. Young, intimating his intention to invest £10,500, in six trustees and himself, for the purpose of establishing a chair of technical chemistry, and requesting the managers and trustees to lease to him the building adjoining the University recently presented by Mr. William Euing, to be altered and fitted up by the trustees. The managers had given their assent, and they now asked the concurrence of the trustees. The Secretary read the deed of trust by Mr. Young in favour of his trustees, directing how the 10,000 guineas were to be appropriated in providing for the lecturer, providing apparatus, altering the building, &c. The trustees were empowered to establish bursaries, scholarships, &c. His six trustees must be trustees of Anderson's University. It was intimated that Mr. Young, with the consent of his fellow trustees, appointed Mr. W. H. Perkin, F.R.S., to the lectureship. This gentleman, like Mr. Young himself, is the founder of an important chemical industry, he being the first discoverer in the department of the aniline or coal-tar dyes. The offer was accepted, with one dissentient.—*Scientific Opinion.*

Spiders' Silk.—A bar of iron 1 inch in diameter will sustain a weight of 28 tons; a bar of steel 50 tons; and, according to computation, based upon the fact that a fibre only 1-4000th of an inch in diameter will sustain 54 grains, a bar of spiders' silk 1 inch in diameter would support a weight of 74 tons.

Contribution to the History of Pyrrol.—N. Lubavin.—It is pretty well known that this substance is the product of the destructive distillation of bones, pit-coal, and other nitrogenous substances. Pyrrol has been only slightly submitted to research. It is known to have the formula C_4H_5N. It does not form salts; is not decomposed by fusing with caustic potassa. Treated with acids, it yields pyrrol-red; while it has the property of colouring a piece of fir-wood, previously moistened with hydrochloric acid, red. About two years ago, M. Goldschmidt discovered that, when pyrrol is oxidised with moist oxide of silver, it is converted into a crystalline substance endowed with the properties of an acid. However, only a very small quantity of this substance was obtained by him. M. Lubavin, although operating upon large quantities of pyrrol, succeeded no better than M. Goldschmidt, when repeating his researches on pyrrol and its oxidation by means of oxide of silver; while the very small quantity of the crystalline substance obtained by him by this reaction proved to be as ready a reducing-agent for the said oxide as the pyrrol itself. Pyrrol appears to be extremely indifferent to any reagents at all, or, if acted upon, is readily converted into pyrrol-red. Sodium does not affect pyrrol at the ordinary temperature of the air: when heat is applied, some gas is disengaged. Potassium, however, acts strongly upon pyrrol; a large quantity of gas is disengaged; heat is developed; and, on cooling, the entire mass solidifies, forming a crystalline compound; this appears to be pyrrol-potassium, since, on treating it with water, pyrrol is obtained unchanged, while, on treating it with iodide of ethyl, ethyl-pyrrol is produced. The potassium combination has the formula C_4H_4KN. When large quantities of pyrrol are operated upon, some resinous substance is also produced. Ethyl-pyrrol is a colourless liquid, which, however, soon becomes first yellow, next red. Its smell is akin to that of oil of turpentine. It is hardly at all soluble in water, and specifically lighter than that fluid. Ethyl-pyrrol becomes resinous when exposed to air; is soluble in hydrochloric acid, thereby becoming deep-red coloured, and emitting dense white fumes. On boiling this solution, no solid substance is deposited, but, on addition of an aqueous solution of caustic potassa, an amorphous, solid substance is precipitated. The vapours of ethyl-pyrrol have the same characteristic property as pyrrol, viz., to render red-coloured a piece of fir-wood previously moistened with hydrochloric acid. The percentical composition of ethyl-pyrrol for the formula $C_4H_4(C_2H_5)N$= Carbon, 75·8; hydrogen, 9·5; nitrogen, 14·7. The boiling point is between 160° and 175° C.—*Berichte d. Chem. Gesel. z. Berlin.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, August 16, 1869.

This number contains, among a large number of purely mathematical, mathematico-physical, and papers on other subjects not at all allied to chemistry, the following memoirs:—

Constitution of Luminous Spectra.—M. Lecoq de Boisbaudran.—The author says, in the year 1865, I stated "that, when the spectral rays of the metals of the alkalies and alkaline earths are classified according to their refrangibility, they are placed according to the chemical properties and the atomic weights of these bodies." The author now says—"I can explain the formation of the spectra by the four following points:—1st, the molecules should present certain inequalities, and should not be solids rotating round a circular axis; and, they must be in rapid motion; 3rd, that motion ought to be an eccentric elliptic; 4th, the ellipse itself should move in a perihelical manner. From the combination of the spherical and elliptical movements, I can explain the formation and the entire mode of existence of a spectrum; that is to say, groups which are repeated in several points of the luminous part, shadowed rays or stripes decreasing either towards the right or left hand, and repetition of these stripes in the spectrum."

Researches on the State Salts are in when Dissolved in any Menstruum.—MM. Berthelot and St. Martin.—The authors find—1st, that there do not exist in solution acid salts formed by a monobasic acid; 2nd, the acid salts formed by a bibasic acid are, when in solution, partly decomposed; 3rd, the quantity of salt thus decomposed increases steadily and continuously when dilution takes place; 4th, the quantity which is decomposed varies according to the relation existing between the neutral salt and the excess of acid; the stability of the acid-salt is increased by the presence of a neutral salt, or by the presence of excess of acid. The authors have, moreover, found that—1st, the acetates of the alkalies are entirely decomposed, when in aqueous solution, by sulphuric, hydrochloric, oxalic, and even tartaric acids; 2nd, ammonia, when added to solutions of acetate or oxalate of potassa, or soda, in solution, does not seize upon any of these acids; 3rd, oxalic acid partly decomposes a solution of chloride of sodium, when, in a litre of water, 14 grms. of oxalic acid and 20 grms. of chloride of sodium are dissolved (larger quantities of these substances cannot be taken, on account of the difficult solubility of binoxalate of soda). The authors found that about 1-10th of the oxalic acid was converted into binoxalate of soda.

Fermentation of Fruit.—MM. Lechartier and Bellamy.—In this paper the authors relate their experiments whereby they discovered that fruit—apples and pears, more especially—when kept, gives off carbonic acid; but, at the same time, in the interior of the fruit, alcohol and acetic acid are formed. We quote the following figures:—Duration of experiment, 184 days; weight of apples, 348·8 grms.; loss of weight, 14·3 grms.; loss of sugar, 26·0 grms.; gas given off, 13·10 grms.; alcohol formed, 10·01 grms.; acetic acid formed, 0·11 grm. From these and some other experiments made by the authors, it appears that fruit of the kind alluded to is best and most advantageously kept so as to admit of free circulation of air round every individual fruit as much as possible. To keep fruit in closed vessels causes rapid destruction.

On Bromotoluen and the Toluidines derived therefrom.—MM. Rosenstiehl and Nikiforoff.—This paper is a critical review of the labours of MM. Koerner, Huebner, and Wallach, and not suited for abstraction.

On Propylamine.—M. Silva.—The substance obtained by this author, by means of a complicated process, is a liquid exhibiting a strongly ammoniacal smell; very alkaline, inflammable, precipitating solutions of alumina, and re-dissolving the precipitate thus formed; also precipitating solutions of salts of magnesia, nickel, cobalt, and iron; boiling point about 50°; vapour density referred to air, 2·01; specific gravity at 0°, 0·7283; formula—

$$(CH_3—CH_2—CH_2)\left.\begin{matrix}\\ H\\ H\end{matrix}\right\}N.$$

In 100 parts:—C, 61·01; H, 15·26; N, 23·73. The author has studied some of the salts this basis forms.

Constitution of Pseudotoluidine.—M. Koerner.—The author discusses in this paper the correctness or incorrectness of certain results published on this subject by M. Rosenstiehl. The paper is full of formulæ and not well suited for abstraction.

Testing the Antiquity of Manuscripts by means of Studying the Age of the Ink Employed in Writing it.—M. Gaultier de Claubry.—The chief result the author points to is that M. Carré's method alluded to by us in a former number of an abstract of this periodical, is entirely unfit to be used as a test for indicating the age of any writing.

Synthesis of Crotonic Aldehyde.—MM. Paterno and Amato.—The authors have tried, but in vain, to prepare this aldehyde by heating, in sealed tubes, aldehyde and chloride of ethyliden. The reason that they publish this, as they themselves confess, very imperfect work, is due to the publishing of the results of experiments on this subject by M. Kekulé.

Preservation of Stone from the Ravages of Cryptogamic Plants by means of the Oxide or Salts of Copper.—M. Robert.—The gist of this paper is, that the pedestals upon which are placed statues made of bronze, or to which copper ornaments are added, are protected by the salts of copper which are gradually formed under the influence of wind and weather; and these salts, being washed down by rain, prevent, by their poisonous action, the formation of small cryptogamic plants, and hence, also, prevent the decay and deterioration of the stone. The author thinks that salts of copper, or copper or bronze ornaments, might be applied successfully to pedestals, as well as buildings, in order to preserve the stone they are made of from decay, the chief cause of which is, according to the author, the growth of minute cryptogamic plants.

We learn from this number that, on the 8th of April last, the Imperial Academy of Sciences of St. Petersburg appointed a committee with a view of propounding measures to be taken in order to submit to an international committee several questions relating to the making of standard weights and measures according to the decimal system. The report of that Russian committee was read at this meeting of the French Academy, and gave rise to a lengthy discussion. The chief points of the Russian report may be briefly stated as follows:—That steps be taken by the Academy of St. Petersburg to induce the Russian Government to use its influence to invite a meeting of delegates of all foreign states, in order to discuss and regulate everything requisite to the proper manufacture of standard weights and measures according to the decimal system; the place of meeting to be afterwards designated; and that M. Jacobi be requested to bring this matter before the meeting of the British Association for the Advancement of Science, at Exeter, and be also requested to urge the necessity of the general adoption of the metrical system by all men of science in all countries.

Bulletin de la Société Chimique de Paris, August, 1869.

From the abstracts of the *procès verbaux* of the meetings of this Society, held on the 4th and 18th of June last, and published with this number, we learn that M. Longuinine spoke about his—

Researches on Birch-Wood Tar.—When this tar is distilled along with water, there is obtained a light, yellowish-coloured oil, which, on being treated with caustic potassa, yields a crystalline compound, due to a peculiar phenol, which constitutes about 1-15th of the entire quantity of oil obtained. The remainder of this oil yields chiefly tereben, boiling and distilling over between 160° and 180°. The phenol obtained exhales the peculiar and well-known smell of Russian leather, chiefly employed for bookbinding purposes.

M. Friedel spoke on the—

Formation of the Chlorides of Acids.—Anhydrous phosphoric acid does not, at 0°, act upon crystallised acetic acid; when this mixture is treated with dry hydrochloric acid gas, chloride of acetyl is formed.

M. Joffre communicated the composition of a native crystalline carbonate of soda found in Fezzan (a great oasis in Tripoli, Africa); this salt is a sesquicarbonate, $2NaO,3CO_2+4HO$.

M. Thiercelin called attention to the formation of the saltpetre beds on the coast of Peru, and states that the beds situated close to sources of water impregnated with common salt are yet quite free from iodine.

M. Bouchardat said that, according to his experiments, cinchonine fuses at from 256° to 262°. Kept at an elevated temperature in a current of carbonic acid, this base begins to volatilise, without decomposition, at 275°; when, however, cinchonine is kept for a length of time at 150°, it is converted into liquid volatile bases.

This number contains the following original papers:—

Synthesis of a New Butylen, Ethyl-Vinyl.—M. Wurtz.—The author mixes zinc-ethyl and bromide of ethylen, heats in a sealed tube up to 140° for some hours, and next leaves the tubes quietly standing for several weeks. Previous to opening the tubes, they are placed in a strongly-cooling mixture, and arrangements made to collect the gas which may escape on opening the tubes into bromine. After proper purification, the bromide obtained constitutes a perfectly colourless liquid boiling at about 166°; sp. gr. at 0°, 1·876. The ethyl-vinyl obtained from this bromide boils at 5°; and, on being re-converted again into a bromide, that latter compound boils again at 166°.

Synthesis of Aromatic Acids.—M. Wurtz.—The method described by the author consists in treating an organic chloride or bromide with chloroxycarbonic ether and sodium-amalgam. In this way, the chlorine or bromine seized upon by the sodium-amalgam is replaced by $CO_2(C_2H_5)$. The author has applied this method in some instances, and thus prepared benzoic ether according to the following formulæ:—

$$\underbrace{C_6H_5Br}_{\text{Bromide of ethyl.}} + CO\left\{\begin{matrix}O\\Cl\end{matrix}\right.\underbrace{C_2H_5}_{\text{Chloroxycarbonic ether.}} + Na_2 = NaCl + NaBr + \underbrace{C_6H_5,CO_2(C_2H_5)}_{\text{Benzoic ether.}}$$

Researches on the Propylic Alcohol of Fermentation.—Dr. G. Chaucel.—This lengthy and very concisely written paper, full of formulæ, does not admit of suitable abstraction.

Ethylic Series of Silicium.—MM. Friedel and Ladenburg.—The authors describe in this paper, at great length, their experiments to obtain compounds wherein silicium replaces one or more atoms of carbon. Silicium-ethyl, $Si(C_2H_5)_4$, is a liquid boiling at from 150° to 154°. Silicium-hexethyl, $Si_2(C_2H_5)_6$, is also a liquid, readily inflammable, and giving off, while burning, fumes of silica; vapour density, 7·96.

On Acetochlorhydrine and Octylglycol.—M. de Clermont.—Acetochlorhydrine of octylen is a liquid, insoluble in water, soluble in alcohol, ether, and acetic acid; rather readily inflammable, and burning with green-bordered flame; boiling point, 225°; sp. gr. at 0°, 1·026. Composition, in 100 parts:—C, 58·11; H, 9·20; Cl, 17·19.

Some New Ferrocyanides and Ferricyanides.—M. Wyrouboff.—This paper is chiefly a critical review of the labours of M. Riendel, published in a German periodical some years ago. This author's paper is too lengthy, and too much filled with a large number of formulæ, to admit of useful abstraction.

Analysis of a Native Carbonate of Soda.—M. Joffre.—Composition, in 100 parts:—Soda, 39·41; carbonic acid, 39·58; water, 19·52; sand, 0·53; oxide of iron, 0·01; carbonate of lime, 0·05; chloride of sodium, 0·46; sulphate of soda, 0·44. This salt, therefore, belongs to the mineralogical species known as urao.

Action of Hydrogen upon Acetylen when Platinum Black is simultaneously present.—M. de Wilde.—The author finds that, when acetylen and hydrogen, both chemically pure, are brought together, at the ordinary temperature, in a space wherein platinum-black is placed, hydride of ethyl is formed—

$$\underset{\text{2 vols.}}{C_2H_2} + \underset{\text{4 vols.}}{2H_2} = \underset{\text{2 vols.}}{C_2H_6}.$$

When less hydrogen is applied, it appears, says the author, that ethylen is formed.

Acetic Derivatives from Mannite.—M. Grange.—This paper and the following—

Acetic Derivatives obtained from Amylum Gum and the Hydrocarbonates (MM. Schutzenberger and Naudin), have been already briefly abstracted from the *Comptes Rendus*, a remark which equally applies to—

Butyrate and Valerate of Isopropyl (M. Silva) and—

New Sulphur Acid.—M. Schutzenberger.

Researches on the Ethers of Phenol.—M. Lipmann.—Ethylen-diphenol, obtained by the author by a complicated series of operations, is, when pure, a solid substance, fusing at 95°, insoluble in water, readily soluble in chloroform, and also in boiling alcohol; formula—

$$\left.\begin{matrix}(C_6H_5)_2\\C_2H_4\end{matrix}\right\}O_2.$$

Ethylen-diphenol sulphuric acid; the lead- and barium-salt of this acid have been studied, the former has the following formula:—

$$\left.\begin{matrix}(C_6H_4SO_3)2Pb''\\C_2H_4\end{matrix}\right\}O_2.$$

Tetrabromide of ethylen-diphenol is a solid substance, crystallising in small needles, fusible at a little above 100°. The real constitution of ethylen-diphenyl is, according to this author—

$$C_6H_5CH_2,C_6H_5CH_2.$$

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 11. 1869.

This number contains the report of the meeting of this Society, held under the presidency of Dr. A. W. Hofmann, on the 28th of June last. From the *procès verbal*, we learn that a committee has been formed for the purpose of erecting a simple, yet appropriate, memorial tombstone on the grave of the late Dr. F. F. Runge, who died at Oranienburg, near Berlin, on the 25th of March, 1867. The deceased was well and deservedly known, and well deserved from science and industry this posthumous memorial of services rendered.

The following papers were read:—

Chlorides of Carbon.—M. H. Kolbe.—Through the kindness of Dr. Marquart, the celebrated practical and operative chemist, and owner of chemical works at Bonn, the author has obtained a large quantity of the solid sesquichloride of carbon, C_2Cl_6. (To some of our readers the fact may be of interest to learn that this preparation has been used with comparative success in the worst forms of Asiatic cholera.) This substance is readily converted into the fluid chloride of carbon, C_2Cl_4, by means of the action of zinc and sulphuric acid, although there is simultaneously formed a compound, C_2HCl_3. Since the compound C_2Cl_4 enjoys the property of combining directly with chlorine and bromine, the author thought it might be possible to make that compound enter directly into combination with two atoms of hyponitric acid. This nitro compound, $C_2Cl_4(NO_2)_2$, is prepared when the simple chloride of carbon, C_2Cl_4, is mixed with hyponitric acid, kept very cold by means of cooling mixture, and next heated in a sealed tube at from 110° to 120°. The quantity of dinitro-perchloride of ethylen, or

dinitro-chloride of carbon, thus obtained is rather small in quantity, since, during the preparation, a mass of by-products are formed, among which is chlorocarbonic oxide. The substance alluded to is a solid volatile body, soluble in alcohol and ether, insoluble in water, crystallises like the sesquichloride of carbon, and, like that substance, cannot be reduced to powder. This compound cannot be fused without decomposition. The elementary analysis gave results leading to the formula $C_4Cl_4(NO_2)_2$.

Compound of Ethylen and Nitric Acid.—M. Kekulé.—The author has caused pure nitric acid, and, next, a mixture of nitric and sulphuric acids, to act upon ethylen. In the first instance, a large portion of the ethylen is destroyed by oxidation; but, with great care, and the application of strongly-cooling mixtures, an oily fluid was obtained, on addition of water in small quantity. Large quantities of this oil were obtained when ethylen was made to pass through a mixture of nitric and sulphuric acids, kept cold by means of very cold water. The substance obtained is, after purification, a colourless oily liquid of 1·472 sp. gr.; its vapour attacks the eyes, and causes headache; it is not volatile with decomposition. Far below its boiling point this substance is decomposed, giving off red vapours; even when water is present, the distillation is impossible without the simultaneous formation of nitrous acid, deutoxide of nitrogen, oxalic acid, glycolic acid, and some glyoxylic acid. The same decomposition takes place when this compound is boiled with solutions of alkalies. The author assigns to this body the empirical formula, $C_2H_4N_2O_5$, but he considers it to be an ether of glycol—

$$\left.\begin{matrix} NO \\ \| \\ C_2H_4 \\ NO_2 \end{matrix}\right\} O \quad \left.\begin{matrix} \\ \\ \\ \end{matrix}\right\} O$$

Phenol-Sulphuric Acid and Nitro-Phenol-Sulphuric Acid.—M. Kekulé.—The author observes that he was the first who pointed out the fact that, when phenol and sulphuric acid act upon each other, there are formed two isomeric sulpho acids, para-phenol-sulphuric acid and meta-phenol-sulphuric acid. Since there have been different experimenters on this subject, some of whom have altogether overlooked this meta acid, and since the author has found that, with different modes of preparation the quantity obtained of this acid varies greatly, he instituted some experiments to ascertain under what conditions either of the two isomeric modifications are chiefly formed. The result obtained is that, when a mixture of phenol and sulphuric acid is left quietly standing at the ordinary temperature, it contains, not only at first, but for weeks after, chiefly the meta acid. When the mixture is heated, the quantity of the para acid increases, and continues to do so until, when the temperature is for some time kept at from 100° to 110°, the para acid only is present in the mixture. When the meta acid, obtained in pure state from its salts, is heated for some time on a water-bath, it is thereby entirely converted into the para acid. As regards the nitro-phenol-sulpho acid, the author found that there does not exist any doubt that, by whatever method this acid is prepared, the product obtained is always identically the same.

Artificial Alizarine.—MM. Graebe and Liebermann.—The authors say the publishing of their French patent on this subject makes it necessary not to delay any further the completion of their brief paper read before this Society, on the 11th of January, on the preparation of alizarine from anthracen. The authors, at the same time, state that, since they reserve their right of publishing full details of experiments and analysis on this topic, they only read a brief, rough, outline sketch. They succeeded in reducing alizarine obtained from madder to anthracen; and, suspecting that alizarine is a chinon acid, the idea of obtaining alizarine artificially became a feasible matter, as may be learned from the following formulæ:—

$C_{14}H_{10}$. Anthracen. $\qquad$ $C_{14}H_6\{(O_2)'' \atop (OH)_2$. Alizarine.

The affair rested upon the possibility of substituting in anthracen, for two atoms of hydrogen, the group $(O_2)''$, characterising the chinons; and, for two other atoms of hydrogen, two atoms of hydroxyl. Prof. Anderson, of Glasgow University, discovered that, when anthracen is treated with nitric acid, oxanthracen is formed; this is, according to the authors, the chinon of anthracen (anthrachinon, $C_{14}H_8(O_2)''$). This substance is also obtained from anthracen, by means of other oxidising agents, as, for instance, bichromate of potassa, and sulphuric or acetic acids. The authors tried to introduce into this anthrachinon two atoms of bromine or chlorine, in order to be able, by this means, to obtain the two atoms of the hydroxyl group, which are wanted. Chlorine does not act readily upon anthrachinon; with bromine, the substitution ensues at 100°. When, therefore, anthrachinon is heated for several hours in sealed tubes placed in a water-bath, after addition of four atoms of bromine, it is converted into bibrom-anthrachinon, while hydrobromic acid is simultaneously formed—

$$C_{14}H_8(O_2)''+4Br=C_{14}H_6Br_2(O_2)''+2BrH.$$

This body is a solid substance, soluble in benzol, crystallising from that solution, or by sublimation, and exhibiting bright yellow-coloured needle-shaped crystals. On being heated with a thoroughly concentrated solution of caustic potassa to about 170° (at which temperature the reaction sets in), the mixture assumes a deep blue colour, and the mass becomes soluble in water, exhibiting thereby the well-known and beautifully violet colour of alizarinate of potassa; when an acid is added to this solution, alizarine is precipitated from it, in the shape of a reddish brown flocculent matter. The following formula exhibits the formation of alizarinate of potassa from bibromide of anthrachinon:—

$$C_{14}H_6Br(O_2)''+4KHO=C_{14}H_6(OK)_2(O_2)''+2KBr+2H_2O.$$

The authors next state that they discovered another method for the preparation of bibromide of anthrachinon, and its conversion into alizarine. Since the bibromide of anthracen is converted, by means of being heated along with nitric acid, into anthrachinon, according to this formula:—

$$C_{14}H_8Br_2+2NHO_3=C_{14}H_6(O_2)''+2Br+2NHO_2,$$

the authors suspected that tetrabromanthracen, $C_{14}H_6Br_4$, would be readily converted into bibromide of anthrachinon by the same means. On trying this experimentally, they found that their opinion proved correct. By treating the bibromide of anthrachinon thus obtained with a strong solution of caustic potassa, alizarine was again obtained. The authors positively state that the artificial alizarine thus obtained is in every respect identical with that obtained from madder; this is, be it observed, the first instance of the preparation of a naturally-occuring vegetable colouring matter by artificial means.

Behaviour of the Salts of Silver towards Iodine.—M. Weltzein.—After referring to experiments made by himself in 1854 and 1860, on this subject, the author states:—(1) When iodine acts upon the nitrate of silver, no free oxygen is given off; (2) that, not the anhydride of nitric acid, but hyponitric acid, is obtained, the reaction being represented by—

$$3AgNO_3+3I=3NO_2+AgIO_3+2AgI.$$

The author further says that he hoped to obtain, by the action of iodine upon the acetate and benzoate of silver, the respective anhydrous acids, but failed, and next winds up his paper with a long series of formulæ, not deduced from his own experiments, but made up from theoretical reasoning. The formulæ are too complicated and lengthy to be quoted.

There follows in this number, under the title of Correspondence, letters written from London, from Zürich (Switzerland), and from Cambridge, U.S. M. Meister, secretary of the Chemische Harmonika, a chemical society established at Zürich, writes—"At our meeting, on the 22nd of June last, MM. Merz and Weith communicated that, when powdered sulphur is strewed on the surface of boiling aniline, a strong evolution of sulphuretted hydrogen gas is observed, while a base containing sulphur is thereby formed. Other organic substances, as, for instance, acetanilide, glycerine, and naphthaline, are acted upon by sulphur in the same way at a higher temperature. When pure and dry hydrogen gas is made to pass through boiling sulphur, sulphuretted hydrogen gas is developed in large quantities."—Mr. W. Gibbs writes from Cambridge, U.S., communicating the results of some experiments made by him on the—

Action of Nitrites of Alkalies upon Uric Acid and Derivatives therefrom.—When uric acid is heated along with a solution of nitrite of potassa or soda, and sulphuric acid, a strong effervescence takes place, the uric acid is completely dissolved, and the fluid contains alloxan and alloxantin. On evaporation to dryness on a water-bath, parabanic acid is obtained, and very small quantities of two peculiar substances—one a red-coloured, the other a bright bluish fluorescent—both flocculent substances. When acetic acid is applied, instead of a mineral acid, the same phenomena are observed to take place; but the filtered solution deposits a very voluminous salt, which, if nitrite of potassa were applied to the experiment, is composed according to the formula $C_4H_2KN_3O_3$. The peculiar acid contained in this salt has been named stryphnic acid, from στρυφνος, bitter astringent, since the acid and its salts exhibit this taste. The formula of the free acid is $C_4H_3N_3O_3$; it appears to be monobasic, and all its salts, except the lead-salt, are soluble in water. The author read this paper, of which only a brief account is here given, before the National Academy of Sciences, the transactions of which are, we believe, regularly published.

Existence of Molecular Compounds in Gaseous State.—M. A. Naumann.—This paper, which is placed under the section of *Mittheilungen*, and is dated from Giessen, the 1st of July last, is a philosophical essay, and not well suited for abstraction.

We beg to remind our readers that during the months of August and September this periodical is not published.

Bulletin de la Societe d'Encouragement pour l'Industrie Nationale, No. 199, July, 1869.

The only paper relating to chemistry in this number is on the—

Use of Extracts of Madder in Calico Printing, and the Part each of the Different Pigments contained in Madder Plays in this Operation.—M. Schutzenberger.—The author begins by stating that, notwithstanding the discovery of aniline and other artificially-made colours (dyes), madder and its preparation yet occupy a first rank among dyes, and not only will continue to do so, but its use will become more extended. The author next reviews, at some length, the history of madder, and preparations obtained from it, during the last forty years, alluding to garancine, flowers, or bloom of madder, and commercial alizarine—that is to say, madder submitted to high pressure steam. To M. Kopp is due the discovery of preparing, on the large scale, the pure colouring matter from madder, and, also, of getting purpurine separately therefrom; this substance is very little used, but the alizarine (the chief tinctorial matter contained in madder) is largely used. At Cosmarros, a town in Bohemia, and at Thann, France, the direct application of alizarine, without the use of mordants, has been most successfully applied, especially in the last-named town, by M. Scheurer. The author enters into some purely technical details on this subject, which, however interesting, we leave out, following him rather to the more purely chemical part of his paper. Madder contains:—(1). Alizarine, $C_{20}H_{10}O_6$, a solid substance, readily crystallising, forming orange-coloured needle-shaped crystals by sublimation by heat, soluble in benzol, also in warm alcohol, yielding, with alkalies, a bluish purple-coloured solution. (2). Purpurine, $C_{20}H_{12}O_7$, a solid substance exhibiting red-coloured, needle-

shaped crystals, when crystallised from alcohol, or, also, by sublimation by heat; but by this latter process, a large portion of the substance is decomposed; soluble in benzol, also in warm alcohol, and yields, with alkalies, red-coloured solutions. (3). Pseudo-purpurine, $C_{30}H_{12}O_{11}$, a solid substance, exhibiting, when crystallised from its solution in benzol, small brick red-coloured needle-shaped crystals; is decomposed by heat, yielding purpurine; soluble in benzol, very slightly soluble in alcohol, even at boiling point, and yields, with alkalies, a red-coloured solution. (4). An orange-coloured matter, $C_{20}H_{12}O_7+2H_2O$, a solid substance, exhibiting, when obtained by the slow evaporation of its alcoholic solution, a crystalline conglomerated mass; is decomposed by heat, yielding purpurine; insoluble in benzol, very soluble in alcohol, and does not yield a solution with alkalies. (5). Purpuro-xanthine, $C_{20}H_{12}O_8$ (?), a solid substance, yielding, either by sublimation, or by evaporation of its solutions in alcohol or benzol, yellow-coloured needle-shaped crystals; sublimes by heat; readily soluble in benzol, as well as in alcohol; and yields, with alkalies, a yellow-coloured solution. As regards the formulæ here quoted, the author desires it to be understood that they represent exactly the percentical composition, but that, in a scientific point of view, these formulæ do not express the constitution of the substances; moreover, C = 12; H = 1; and O = 16 in this case. Each of these five substances is fit for use as a dyeing material; but alizarine alone is the dye *par excellence*. It appears, says the author, that the solidity (the fastness or goodness) of the different tints of colours produced by these dyes varies in the inverse ratio of the quantity of oxygen contained in the substance in excess of the hydrogen. Where the quantity of oxygen increases, we come from a more violet red to a bright red, and at last to brick red; and from bright violet colour to a more dirty violet, and, next, to greyish violet. Science has to elucidate practice in many points in respect of madder. No doubt a thorough study of this subject will enable us to find the key to the best mode of so mixing the different bodies to be described, as to produce pigments precisely suited to each peculiar shade of colour required.

Quantity of Copper Produced in the Year 1866 over the Whole World.—M. Petitgand.—The quantity of this metal raised on the entire globe, in the year alluded to, the latest period that statistical records of this kind have been reliably brought together, amounts to 93,415 tons, which is nearly double the quantity raised in 1846. From the statements made by this author, there appears to be an increasing tendency to a lower cost price of this metal. Large and valuable deposits of excellent copper ore known to exist, especially in Polynesia, are as yet untouched.

Moniteur Scientifique, No. 304, August 15, 1869.

This number contains the following original papers and communications:—

Limit of Magnetisation of Iron and Steel.—M. Waltenhofen.—The result of the author's researches on this subject are, that the magnetic moment of the unit of weight of iron may attain a certain limit which is constant and independent of the form and dimensions of the electro-magnet. The absolute value is about 2100 absolute units, expressed in milligrammes. The limit of magnetisation which soft iron can temporarily attain is about five times greater than the permanent magnetism obtained with steel bars, which rarely exceeds 400 units to the milligramme.

Mercury Mines of Almaden.—M. Jouglet.—From this lengthy paper, we learn that mercury, as metal, has been known from the most remote antiquity—that there have been mines worked for mercury ore in Asia Minor in the time of Xenophon; the mines of Almaden, Spain, is yet the largest source of mercury for Europe. The cost of 100 kilos. of the ore is, everything included, only 16 francs and 10 centimes; but it yields, as this author says, by unsuitable management, only 6·9 per cent of mercury, 100 kilos. of which cost, on the spot, 141 francs and 30 centimes; but at Sevilla the price is already 177 francs and 80 centimes, in consequence of cost of transport and the iron vessels in which the metal is carried. The average quantity of mercury produced annually amounts to about 15½ tons, by weight.

Poisoning Caused by Green Tarlatan.—M. Bobierre.—The author says that he obtained from Nantes a sample of this kind of tissue, which, on being tested, was found to contain 10·3 grms. of Schweinfurt green (arsenite of copper) to the square metre, equivalent to 6·03 grms. of arsenious acid. The full dress made of this tissue contained, by weight, no less than 391·4 grms. of arsenite of copper, equivalent to 229 grms. of arsenious acid. At even every slight shaking of the tissue, clouds of a greenish dust came off, which readily explain the poisoning of the party who made the dress. The author tested—1st, by treating the tissue with an alkaline lye, passing chlorine through the solution, and converting the arsenic acid into ammonio-arsenite of magnesia: 2nd, by estimating the quantity of black oxide of copper left after burning the tissue in a red-hot muffle.

NOTES AND QUERIES.

Gas-Works' Residuum.—Can any of your readers give me the name of the most practical work on the conversion of gas-works' residuum.—R. W. Johnson.

Utilisation of Waste Vulcanised Rubber.—Would you kindly answer the following question through your Notes and Queries' column?—In large rubber works, how are the waste cuttings, &c., of vulcanised rubber utilised?—D. J. O.

Terra Alba.—"Selenite" desires some information about the artificial sulphate of lime called, in commerce, terra alba. How is it made? by evaporation of sea-water or brine? Where? Why does its quality vary? At what price is it sold? Its uses? To what extent sold? Is it exported largely? To what countries?

Octylic Alcohol.—Can any of your readers kindly inform me as to the best method of preparing octylic alcohol from saponified castor-oil? I cannot find any means of preventing its frothing over on being heated. I have used an apparatus made of tinned iron for distillation, but find, even though the apparatus is 18 inches high, by 3 inches in diameter, and I only put 3 inches of saponified castor-oil and potash into it, that three-fourths of the matter froths over from the lead-off tube. I can nowhere find any instructions for preventing such an occurrence. I have raised the heat gently, but it makes no difference at all.—G. P. Clarke.

Aniline Colours.—If "Alexis" will have the kindness to state what particular colours he refers to, and the strength in ounces per gallon, I shall be able to furnish him with particulars.—J. W. Slater.

Aniline Colours.—"Alexis" is referred to Reimann's work on aniline colours, edited by the Editor of this journal. The work contains everything which can be desired, and far more fully and completely than any reply we could give in limited space. The work may be inspected at the Library of the Commissioners of Patents; but it should be in the possession of any one who puts queries as "Alexis" does.

Tungstate of Soda.—M. A. Burn is informed that most salts are bad conductors of heat. As to the price of the tungstate of soda, we could not well give any information, since it would greatly depend upon the quantity required; but why will not alum or borax do, or even common salt, provided it be free from deliquescent salts? All these salts are cheaper than the tungstate, and would render paper fire-proof, in the sense of preventing it bursting into flame on being ignited.

Printing Scarlet.—No salts of mercury could be boiled with water in copper, or even iron vessels, without decomposition taking place. If you want to apply the brilliant scarlet colour exhibited by biniodide of mercury, you should apply it by fixing it to the cloth by means of albumen. As far back as the year 1827, it was tried to fix this beautiful pigment by means of mordants, but it did not succeed well. M. Bor, of Amiens, published, in 1842, a method of printing upon cotton a colour resulting from a somewhat complicated process, but, really, the mercury compound you allude to; the printing of this scarlet upon wool and silk does not answer at all. There are various methods of preparing the scarlet biniodide, but for these we must refer you to works on chemistry; however, you could only obtain success by avoiding the use of metallic vessels, and operating in vessels of glass or porcelain. The scarlet of the biniodide of mercury is less beautiful than that of pure vermillion (sulphide of mercury).

Estimation of Phosphates in Manures.—A superphosphate, if properly made, cannot become again insoluble, as long as the superphosphate is acid, which can be readily ascertained by the behaviour of the manure with blue litmus paper, which, when brought into contact with the manure, should turn red; when, however, much iron is contained in a superphosphate (the iron being naturally present in the native phosphate employed in manure making), then it may happen that a basic phosphate of iron is formed by the action of the air—and this may constitute the so-called "reduced" phosphate. No makers of superphosphate will use more sulphuric acid than is precisely required: it would be a loss to them. One equivalent of bone-ash requires two equivalents of sulphuric acid; or, in other words, 155 parts of tribasic phosphate of lime require 98 parts of concentrated sulphuric acid, for being converted into superphosphate of lime. Most, if not all, of the manufacturers of superphosphates are men who conduct their business with conscientious care and upon scientific principles, well knowing beforehand the materials they have to deal with, so as to ensure efficiency of the produce without excess of labour or materials.—Chemicus.

TO CORRESPONDENTS.

*** The Students' Number of the Chemical News will be published on Friday, September 17th. Gentlemen holding official positions in the Universities, Medical Schools, &c., of the United Kingdom, where Chemistry and Physical Science form a part of the Education, who have not yet forwarded the necessary information to our office for publication in that number, will confer a favour by sending it with the least possible delay.

Bichrome.—Your letter involves a legal question; we would rather not offer any advice on the subject.

Walter Weldon.—In reporting a paper by this correspondent in our last issue, he was styled "F.C.S." He has written to ask us to correct this error, as he is not yet a Fellow of the Chemical Society.

E. B.—("Explosion Caused by Ammonia Gas.") In the original paper it reads exactly as printed in our issue of the 3rd inst: we believe, however, it is a typographical error in the German paper, and we intended to have made a remark to this effect in our abstract, as we are well aware that no iron vessel of the dimensions specified would stand such an enormous pressure; we venture the explanation that the total force exerted at the time of the explosion was 20,000 pounds, not on the square inch, but over the entire surface of the vessel. On inspection of other German periodicals we find that they also have reproduced this error. The vessel was made of wrought-iron.

THE CHEMICAL NEWS.

Vol. XX. No. 512.

(STUDENTS' NUMBER.)

SCHOOLS OF CHEMISTRY.

EXAMINING BOARDS.

UNIVERSITY OF LONDON.

Candidates for any Degree granted by this University are required to have passed the Matriculation Examination, to which no candidate is admitted unless he has produced a certificate showing that he has completed his sixteenth year.

The Fee for this Examination is £2.

The Examination includes the following subjects:—

Natural Philosophy.*

Mechanics—

Composition and Resolution of Statical Forces.

Simple Machines (*Mechanical Powers*):—Ratio of the Power to the Weight in each.

Centre of Gravity.

General Laws of Motion, with the chief Experiments by which they may be illustrated.

Law of the Motion of Falling Bodies.

Hydrostatics, Hydraulics, and Pneumatics—

Pressure of Liquids and Gases, its equal diffusion, and variation with the depth.

Specific Gravity, and modes of determining it.

The Barometer, the Syphon, the Common Pump and Forcing-Pump, and the Air-Pump.

Acoustics—

Nature of Sound.

Mode and rate of Propagation of Sound.

Musical Tones.

Optics—

Laws of Reflection and Refraction.

Formation of Images by Simple Lenses.

Chemistry.

Heat—its sources. Expansion. Thermometers—relations between different Scales in common use. Difference between Temperature and Quantity of Heat. Specific and Latent Heat. Calorimeters. Liquefaction. Ebullition. Evaporation. Conduction. Convection. Radiation.

Chemistry of the Non-Metallic elements; including their compounds as enumerated below—their chief physical and chemical characters—their preparation—and their characteristic tests.

Oxygen, Hydrogen, Carbon, Nitrogen. Chlorine, Bromine, Iodine, Fluorine. Sulphur, Phosphorus, Silicon.

Combining Proportions by weight and by volume. General nature of Acids, Bases, and Salts. Symbols and Nomenclature.

The Atmosphere—its constitution; effects of Animal and Vegetable Life upon its composition.

Combustion. Structure and Properties of Flame. Nature and composition of ordinary Fuel.

Water. Chemical peculiarities of Natural Waters, such as rain-water, river-water, spring-water, sea-water.

Carbonic Acid. Carbonic Oxide. Oxides and Acids of Nitrogen. Ammonia. Olefiant Gas, Marsh Gas, Sulphurous and Sulphuric Acids, Sulphuretted Hydrogen.

Hydrochloric Acid. Phosphoric Acid and Phosphuretted Hydrogen. Silica.

* The knowledge required of these subjects in Natural Philosophy is such as may be attained by attending a course of experimental lectures.

Bachelor of Science (B.Sc.).

This Degree is conferred on candidates who pass a satisfactory examination in Mathematics, Mechanical and Natural Philosophy, Botany and Vegetable Physiology, Zoology, and Chemistry.

First B.Sc. Examination.

No Candidate (with the exception of such as have obtained Honours at the Matriculation Examination in the preceding January) is admitted to this examination within one academical year of the time of his passing the Matriculation Examination.

The Fee for this Examination is £5.

The examination is conducted by means of printed papers; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the Candidates to pass, *viva voce* questions to any Candidate in the subjects in which they are appointed to examine.

The First Examination includes the following subjects:—

Natural Philosophy.

Heat—

Sources of Heat; conduction—convection.

Effects of Heat; expansion generally—of water—of gases and vapours; liquefaction; vaporisation; latent heat; expansive force of steam; dew-point; gases and vapours compared.

Specific Heat.

Thermometers; Pyrometers.

Heat in the Radiant state.

Electricity.

Sources of Electricity.

Static Electricity; dual character—insulation—induction—specific inductive capacity—equivalent antithetic states—disruptive discharge—convection; Electroscopes—Leyden Jar, &c.

Dynamic Electricity; Conduction—the electric current—derived currents—induction of currents; Voltaic Pile and other voltaic arrangements.

Thermo-Electricity; Electro-Thermometer.

Magnetism—

Magnets, the Earth, &c.; Induction—communication—retention—Magnetic relations of iron, steel, &c.

Electro-Magnetism—as in the spark—in conducting media—in soft iron; Magneto-Electricity; principle of Electro-magnetic and Magneto-electric machines.

Terrestrial Magnetism.

Inorganic Chemistry.

Matter; simple and compound.

Elementary bodies classed. Metallic and Non-Metallic bodies.

Chemical Combination and Mechanical Mixture. Solution.

Outlines of Crystallography. Isomorphism. Dimorphism. Allotropic conditions of matter. Chemical Affinity. Laws of Combination by weight and by volume, as deduced from the history of the individual elements. Equivalent Numbers. Equivalent Volumes. Symbolical Notation, including questions on the Unitary System. Formulæ. Nomenclature.

Chemical actions produced under the influence of Heat. Nature of Combustion. Structure and properties of Flame. Principles of Illumination. Chemical action of Light. Photography.

Oxygen. Ozone.

Hydrogen. Water.

Nitrogen. Chemical constitution of the Atmosphere. Diffusion of Gases. The Oxides of Nitrogen; Nitric Acid. Ammonia.

Chlorine, Bromine, and Iodine. Their compounds with Oxygen and Hydrogen. Theory of Bleaching.

Fluorine and Hydrofluoric Acid.

Sulphur. Sulphurous Acid. Manufacture and Chemical applications of Sulphuric Acid. Other Oxygen compounds of Sulphur. Sulphuretted Hydrogen.

Phosphorus. Oxygen and Hydrogen compounds of Phosphorus. Theory of Acids. Monobasic, Dibasic, and Tribasic Acids.

Carbon. Carbonic Oxide and Carbonic Acid. The principal Hydrogen compounds of Carbon. Manufacture of Coal Gas.

Silicon and Boron. Their compounds with the elements previously enumerated.

Metals. Characters of Metals as a class. Metallurgical Processes. Alloys. Classification of the Metals.

Potassium. Nitre. Gunpowder. Theory of the action of Gunpowder.

Sodium. Manufacture of Carbonate of Soda.

Barium. Strontium. Calcium. Mortars. Cements.

Magnesium. Aluminium. Glass. Porcelain.

Manganese. Iron. Composition and properties of Cast-Iron, Wrought-Iron, and Steel. Chromium.

Cobalt. Nickel. Zinc. Cadmium.

Lead. Manufacture of White-Lead.

Copper. Mercury. Bismuth. Tin. Arsenic. Antimony.

Silver. Gold. Platinum.

Principal compounds of the Metals with the Non-Metallic elements. Theory of Salts.

Principles of Mineral Analysis.

Principles of Electro-Chemistry.

For the First Examination, a knowlege of Inorganic Chemistry only is necessary.

EXAMINATION FOR HONOURS.

Candidates for Honours in Chemistry are examined in any of the following subjects, at the option of the Examiners:—

Elementary Substances and their combinations.

Electro-Chemistry.

Radiant Chemical Action.

In the Examination for Honours, the Candidate, being not more than twenty-two years of age, who most distinguishes himself in Chemistry and Natural Philosophy, will receive an Exhibition of Forty pounds per annum for the next two years.

SECOND B.Sc. EXAMINATION.

Candidates for this Examination who have not previously taken the Degree of B.A. shall be required either to have passed the First B.Sc. Examination at least one Academical year previously, or to have passed the First M.B. Examination, in this University.

The Fee for this Examination is £5.

This Examination embraces Organic Chemistry, including the following subjects:—

Ultimate analysis of Organic bodies. Calculation of Empirical Formulæ. Methods of controlling Empirical Formulæ. Determination of the Equivalents of organic acids and bases; examination of products of Decomposition; determination of the Vapour-density of volatile bodies.

Law of Substitution. Compound Radicals. Homologous Series.

The Chemical history of the Cyanogen group. Cyanogen. Hydrocyanic Acid. Cyanic Acid and Urea. Fulminates. Cyanuric Acid. Sulphocyanic Acid. Chlorides of Cyanogen. Uric Acid.

Amylaceous and Saccharine substances. Fermentation. Alcohol, Wine, Beer, Bread, &c.

Homologues of Alcohol. Ethers, simple and mixed. Oxidation of Alcohol. Aldehyd and Acetic Acid, and their homologues. Anhydrides, simple and mixed. Compound Ethers.

Diatomic Alcohols and their Acids, Glycol and Oxalic Acid and their homologues.

Triatomic Alcohols. Glycerine. Fatty and Oily bodies, Saponification.

Vegetable Acids;—the principal.

Ammonia and its derivatives. Ammonium and Ammoniacal Salts. Amides and Amines; their Classification. The chief natural Organic Bases.

Colouring Matters. Indigo and its derivatives. Principles of Dyeing.

The chief constituents of the Vegetable organism. Cellulose. Vegetable Fibrin. Albumin, Casein, Glutin, &c.

The chief constituents of the Animal organism. Animal Fibrin, Albumin, Casein, Gelatin. Blood, Milk, Bile, Urine, &c.

Decay, Putrefaction. Destructive Distillation.

The Chemical principles of the process of Nutrition and of Respiration in Plants and Animals.

EXAMINATION FOR HONOURS.

The Candidate, not more than twenty-three years of age, who, in the Examination for Honours, most distinguishes himself in Chemistry, will receive Fifty pounds per annum for the next two years, with the title of University Scholar.

DOCTOR OF SCIENCE (D.Sc.).

No Candidate is admitted to the Examination for the Degree of D.Sc. until after the expiration of two Academical years from the time of his obtaining the Degree of B.Sc. in this University.

Candidates for the Degree of D.Sc., in any year, must give notice of their intention to the Registrar, and pay to him a Fee of Ten pounds, on or before the 1st of April.

Chemical Candidates can be examined either in Inorganic or Organic Chemistry; but no Candidate will be approved by the Examiners unless he has shown a thorough practical knowledge* of the *Principal Subject*, and a general acquaintance with the *Subsidiary Subject*, or *Subjects*, specified as belonging to the Branch so selected.

Inorganic Chemistry.

Principal Subject—Inorganic Chemistry.

Subsidiary Subjects—Either Organic Chemistry; or, Mineralogy, Crystallography, and Chemical Technology in its relations to Inorganic Chemistry.

Organic Chemistry.

Principal Subject—Organic Chemistry.

Subsidiary Subjects—Either Inorganic Chemistry; or, Chemical Technology, in its relations to Organic Chemistry, and the Chemistry of Animal and Vegetable Life.

EXAMINATIONS IN CONNECTION WITH THE DEPARTMENT OF SCIENCE AND ART, SOUTH KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom.

This sum is administered by the Science and Art Department.

The object of the grant is to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The following are among the Sciences towards instruction in which aid is given:—Acoustics, Light, Heat, Magnetism, and Electricity, Inorganic Chemistry, Organic Chemistry, Geology, Mineralogy, Mining, Metallurgy.

The assistance granted by the Science and Art Department is in the form of—1. Public Examinations, in which Queen's Medals and Queen's Prizes are awarded, held at all places complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

* It must be understood that the Candidate for the Degree of D.Sc. is expected to be so fully conversant with the Principal Subject he may select, as to be able to go through any examinational test (whether theoretical or practical) of his acquirements in it that can be fairly applied.

Examinations in all the before-mentioned Sciences are held annually about May, through the agency of the Local Committee (which must consist of not less than five well-known responsible persons) in any place in the United Kingdom which complies with the requisite conditions. The Examinations are of two kinds, but held on the same evening and conducted by the same committee. *a*. The class examinations for students under instruction in Science Classes, whether taught by teachers qualified to earn payments on results or not. *b*. The honours examinations, of a highly advanced character.

The class examination is of two grades or stages; the first stage or elementary examination, and the second stage or advanced examination.

Application for examination must be made before the end of March, stating the number of persons and the subject or subjects in which they are to be examined.

At the May class examinations the grades of success are:—in the first stage or elementary paper, first, second, and third class; and in the second stage or advanced paper, first and second class. For the third or lowest class the standard of attainment is only such as will justify the Examiner in reporting that the instruction has been sound, and that the students have benefited by it. The standard may be raised from year to year.

To all successful students are given printed lists of results showing their position. To the first class in both stages Queen's Prizes are given, consisting of Books or Instruments' chosen by the Candidates from lists furnished for that purpose.

Four medals, one gold—one silver, and two bronze—are given in each subject for competition among the *bona fide* students of Science Classes who either come within the category of persons on account of whom payments can be earned, or who are under seventeen years of age. The Payments on results are made either directly to teachers or to the committee or managers of the school. Persons are qualified to earn payments who have—(*a*) obtained certificates as teachers in any of the before-mentioned sciences according to the rules in force previous to January, 1867; or (*b*) obtained a First or Second Class at the May examination since that date; or (*c*) who have taken honours at the May examination.

No payments are made to a teacher on account of instruction given in subjects in which he is not so qualified.

The student must have received 25 lessons at least from the teacher or teachers in each subject in which payment is claimed since the last examination, each lesson being an attendance at a meeting of the school of at least three-quarters of an hour's duration on a separate day.

There are two Scholarships provided—the Elementary School and the Science and Art Scholarships. In both cases the scholar must be from 12 to 16 years of age and must have passed in a branch of science at the May examination.

Building Grants for New Schools may be made at a rate not exceeding 2s. 6d. per square foot of internal area, up to a maximum of £500 for any one school, under certain conditions.

A grant towards the purchase of apparatus, diagrams, &c., of 50 per cent on the cost of them, is made to Science Schools and Classes in Mechanics' and similar institutions with a properly constituted committee.

Science teachers who have taught two years consecutively, and passed not less than thirty students each year, are allowed second class railway fare and £3 towards their expenses while living in London for the purpose of visiting the South Kensington Museum and other Metropolitan institutions, in order that they may acquire for the benefit of their students a knowledge of the latest progress in those educational subjects which affect the schools, on condition that they remain there five days at least.

CHEMICAL LECTURES.

UNIVERSITY COLLEGE.

WINTER TERM (Oct. 4 to March 31).

Chemistry.—Professor Williamson, Ph.D., F.R.S.

Lectures daily, except Saturday, from 11 to 12 a.m:

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the Whole Course of Lectures, £6 6s.; for a Half Course, £3 3s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise-Class—for the Course, £2 2s.; for the Half Course, £1 1s.

The Instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of Exercises and personal instruction on the subject of the Lectures by Tutors, under the direction of the Professor.

Students cannot profit duly by attendance on the Lectures unless they work at the subject of each Lecture so as to make it their own.

Attendance on the Tutorial part of the Class enables Students to do their work more effectually and rapidly than they can do it by themselves.

The First Half of the Course to Christmas includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The following order of subjects is adopted in it:—

Heat.—Instruments for measuring Temperature. Decompositions produced by Heat. Expansion. Tension of Vapours. Conduction. Convection. Calorimeters. SpecificHeat. Latent Heat. Evolution of Heat by Chemical Action, and by Mechanical Action. Mechanical equivalent of Heat.

Light.—Photometry. Refraction and Dispersion of Light. Study of Spectrum. Heat Rays. Chemical Rays. Construction of common Optical Instruments. Double Refraction. Polarisation. Chemical applications of Phenomena of Polarisation. Combinations and Decompositions produced by Light and Actinic Rays. Photography.

Electricity and Magnetism.—Simple Magnetic Instruments. Magnetic and Diamagnetic Bodies. Electrical Machine, Electrophorous, &c. Positive and Negative Electricity. Electrometers. Conduction. Induction. Leyden-jars, &c. Discovery of Galvanism. Various forms of Battery. Study of the Chemical Action of Galvanic Batteries. Galvanometers. Heating Effects of Battery in relation to Chemical Action. Thermo-Electricity. Rheostat, &c.

Oxygen.—Theory of Combustion. Hydrogen. Nitrogen. Composition and chief changes of the Atmosphere. Carbon, Chlorine, Bromine, Iodine, and Fluorine. Sulphur, &c. Phosphorus. Boron. Silicon.

The chief compounds of these non-metallic elements among themselves are studied in relation to their production, properties, and decompositions. The proportions by weight and by volume in which they combine are explained and illustrated in connection with the atomic theory.

The Second Half of the Course, extending from January to March, includes the following subjects:—

I. Preparation and properties of the chief metals, including their characteristic reactions and most important salts. Detection of Metallic Poisons. Quantitative Estimation of Metals. Principles of Classification. Monatomic, Diatomic Metals, &c.

A weekly *vivâ voce* examination is held during the First Half Course and the commencement of the Second Half Course.

II. *Organic Chemistry*.

This commences in the second week in February, and occupies five Lectures weekly till about the end of March. It includes a study of the characteristics and metamorphoses of the chief organic acids, bases, alcohols, ethers,

colouring-matters, &c. Methods of ultimate and proximate analysis. Determination of molecular weights. Theory of types; of compound radicals. Phenomena of ermentation, &c.

Practical Chemistry.

Mondays, Tuesdays, Thursdays, and Fridays, from 12 to 1.

The Course consists of about Forty Lessons, the first twenty being given in the five weeks preceding the Christmas Vacation, the remainder immediately after it.

The First Half includes the portion of Chemistry required for the Matriculation Examination.

For particulars, see the Prospectus of the Summer Session.

Fee for the Course, £4 4s.; Half Course, £2 12s. 6d.

SUMMER SESSION (May 2 to July 23)

Practical Chemistry.—Professor Williamson, Ph.D., F.R.S.

I. *Elementary Course.*

About Forty Lessons, of one hour each, on Tuesday, Wednesday, Thursday, and Friday, from 11 to 12, commencing in the first week of May. Students are taught the construction and use of apparatus for the preparation of the most important gases, acids, &c. The characteristic tests for the presence of the common acids and bases, including the chief metallic and other poisons. Also the processes for separating these bodies from one another.

Solutions are frequently given in the class for investigation.

The first six weeks of the Course are occupied by the study of the chief non-metallic elements, and their simple compounds. Metallic salts, &c., are subsequently studied.

Fee for the Course, £4 4s., including cost of materials and apparatus.

II. *Senior Course.*

About Ten Lessons, of two hours each, on Mondays, from 10 to 12, commencing in the first week in May. The Course includes tests for fixed and volatile organic acids, nitrogenised acids, sugars, glycerine, &c.; organic bases and alkaloids, constituents of blood, milk, urine, &c.

Volumetric methods of quantitative analysis of acids, alkalies, urea, prussic acid, iron, &c., are practised.

Fee for the Course, £2 2s., including cost of materials and apparatus.

III. *Summer Matriculation Course.*

Professor Williamson, F.R.S., assisted by Mr. F. S. Barff, M.A., F.C.S.

This Course includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Course consists of about Twenty Lessons in Practical Chemistry, and of an equal number of Oral Lessons. The Practical Lessons include the preparation of the common gases and acids, &c., and the study of their characteristic properties in relation to the elementary laws of combination.

The other lessons are chiefly devoted to those parts of the subject which require fuller oral explanation than is given in the practical lessons. They include numerous exercises and questions, to which answers in writing are given by the Students. These Lessons will begin on Wednesday, April 6th, at 11 a.m.

The Class will meet on the first five week days, from 11 to 12; and some other Meetings will be announced when the Class has assembled.

Fee for the Class, £4 4s., including cost of materials and apparatus.

Analytical and Practical Chemistry.

BIRKBECK LABORATORY.

The instruction in the Laboratory is intended for beginners as well as for more advanced students. It includes practice in the construction and use of apparatus for preparing the common gases, acids, bases, salts, &c. study of the qualitative methods of detecting and separating mineral or organic bodies from one another; also quantitative analysis in the wet way, organic analyses, vapour-densities, &c.; instruction in gas analysis.

More advanced students are instructed in the methods of original research, especially in organic chemistry.

When accompanied or preceded by attendance on the Lectures on Chemistry, the Laboratory Course qualifies Students in the application of Chemistry to the Manufacturing Arts, Metallurgy, Medicine, or Agriculture, &c. Instruction is given in the principles and processes of Gas Analysis.

The Laboratory and Offices are fitted up completely with the most improved apparatus and utensils for experimental research, both for beginners and for advanced Students. They are open daily, from 9 a.m. to 4 p.m., from the 4th of October until the end of July, with a short recess at Christmas and at Easter. Saturday, from 9 to 2.

Fees for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials. A deduction of about 40 per cent is made for Students who can attend only three fixed days per week.

A Gold Medal and Certificates of Honour are competed for by Students entered for the Session.

EVENING CLASSES.

The Session is divided into three Terms, each of ten complete weeks, exclusive of vacations—

I. The Michaelmas Term, beginning on Monday, the 11th of October, and ending on Thursday, December 16th.

II. The Lent Term, beginning on Monday, the 10th of January, and ending on Thursday, March 17th.

III. The Summer Term, beginning on Monday, the 21st of March, and ending on Thursday, June 9th, the Easter Vacation extending from the 14th to the 25th of April, both days inclusive.

The object of these Classes is to extend the benefits of the College Tuition especially to gentlemen engaged elsewhere during the day, and to provide Instruction in subjects not taught in the ordinary College Classes.

The Beadles have orders to admit gentlemen to any of the Classes, with the permission of the Professor or Teacher, as occasional visitors.

The Library is open for the convenience of the Students between 6.30 and 8.30 on the evenings when the Classes meet, except when it is wanted for other purposes.

Elementary Chemistry—Theoretical and Practical.

Professor Williamson, F.R.S., and Mr. Jones. Monday, from 7.30 to 9.30.

A Course of Twenty Lessons, of two hours each, in the Michaelmas and Lent Terms.

The elements of Chemistry are explained to the Class, and the experiments illustrating the subject are performed by the Students.

The subject will be the common Non-Metallic Elements and the common Metals, their Compounds and chief Properties, and the best methods of distinguishing and separating them.

All the experiments and analyses are repeated by each Student, or by not more than two Students jointly.

Fee, including the cost of materials, &c., £2 2s. per Term.

ROYAL SCHOOL OF MINES AND COLLEGE OF CHEMISTRY.

Professor of Chemistry.—Dr. E. Frankland, F.R.S.

The instruction in Chemical Science embraces:—

1. A Course of Lectures on Experimental Chemistry with special reference to the applications of Chemistry in the Arts and Manufactures.

2 A systematic Laboratory Course for the Practice of Chemical Analysis.

Chemical Lectures.—The Course consists of Forty Lectures on Mineral Chemistry and Thirty Lectures on Organic Chemistry.

The Lectures are delivered at the Royal College of Chemistry, Oxford Street.

Chemical Laboratory.—The general Laboratory for instruction in chemical manipulation, in qualitative and quantitative analysis, and in the method of performing chemical researches, is under the direction of Dr. Frankland. The Royal College of Chemistry having become the property of the Government, its Laboratories are used for the instruction of the pupils of the Royal School of Mines.

There are three terms in the collegiate year, of three months each, commencing in the first week of October, January, and April respectively. The Laboratory hours are from 10 a.m. to 5 p.m., with the exception of Saturdays, when the Laboratory closes at 2 o'clock.

Each Laboratory Student works independently, there being no classes. All operations are superintended by the Professor and his assistants. A table with drawers, cupboards, and shelves, is appropriated to every pupil. The Institution supplies gas, fuel, and reagents. The larger and more expensive instruments of the Laboratory, such as air-pumps, thermometers, barometers, condensers, &c., may be used by the students, who are held responsible for their safety. The students have to provide themselves only with the apparatus specified in the Laboratory regulations. More advanced students engaged in private researches have to supply themselves with such materials as are not included amongst the ordinary reagents of the Laboratory.

Professor of Metallurgy.—Dr. Percy, F.R.S.

The course of instruction in Metallurgy consists of Lectures and Laboratory practice.

The object of the Lectures is the communication of such instruction as the student may be able to apply to the greatest practical advantage, when he may be subsequently engaged in conducting any metallurgical process.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy. The nature of this instruction will be adapted to the special requirements of the Students. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c.; and the examination of ores and metallurgical products.

The ability of the student to make trustworthy assays is in every case thoroughly tested; and no certificate of competency is given to a student who has not furnished satisfactory proof that he is able to obtain accurate results.

There are three terms in the collegiate year, of three months each. The Laboratory hours are from 10 to 4 during November, December, January, and February; and from 10 to 5 during the other months, with the exception of Saturdays, when the Laboratory is closed.

The charge for instruction in the Metallurgical Laboratory is £15 for three months; £12 for two months; and £7 for one month.

Lectures to Working Men.—Short courses of lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as to illustrate, within the period of two years, the principal subjects taught at the Institution. Those for the ensuing Session include:—Chemistry, Physics, Applied Mechanics, Metallurgy.

KING'S COLLEGE.

Professor of Chemistry—W. A. Miller, M.D. V.P.R.S.

Professor of Practical Chemistry—C. L. Bloxam.

Students of the first and second years are admitted to the Course of Theoretical and Applied Chemistry. The Course commences with a view of the forces which concur to the production of Chemical Phenomena, after which the laws of Chemical Attraction are discussed, and the Non-metallic Elements and their principal Compounds are described,

The metals and their principal compounds are next examined, care being taken to point out the applications of the Science to the Arts, and the processes of the different Manufactures of Metallurgy, and of Domestic Economy, are explained and illustrated.

Examinations of the Class, both *vivâ voce* and by written papers, are held at intervals during the course at the usual Lecture hour. Dr. Miller has published a work on Chemistry, which is used as a text-book by the class.

Third Year.—Students who have completed six Terms in this Department are admitted to a Course of "Practical Chemistry," consisting of Twelve Demonstrations in each term; and they go through a course of Manipulation in the most important operations of Chemistry, including the first steps of Analysis.

Any Student of this department may be admitted to this Class at any period of his study, on payment of an extra fee.

Experimental and Analytical Chemistry in the Laboratory.—The object of this Class is to afford to Students who are desirous of acquiring a knowledge of analysis, or of prosecuting original research, an opportunity of doing so under the superintendence of the Professor and Demonstrator; Students may enter, upon payment of the extra fees, at any time except during the vacation, and for a period of one, three, six or nine months, as may best suit their convenience. The laboratory hours are from ten till four daily, except Saturday, on which day the hours are from ten till one.

In addition to the Laboratory fee, each Student defrays the expenses of his own Experiments. The amount of this expense, which is comparatively trifling, is entirely under his own control.

Analytical and Experimental Chemistry.—Besides the Course of Chemical Lectures and the Summer Class of Practical Chemistry, provision is made for those Students who wish to become more minutely acquainted with the practical details of the science. By means of this Class each Student is enabled to familiarise himself with the methods of analysis and research. After passing through a preliminary course of analytical operations, each Student devotes himself to such portions of the science as are most interesting to himself, or most likely to be practically useful to him. The Daniell Scholarship of £20, tenable for two years, is given every alternate year for original research in the Laboratory.

The Fees for admission to the Laboratory Class, exclusive of materials, are, for one month, £4 4s.; for three months, £10 10s.; for six months, £18 18s., &c.

EVENING CLASSES.

Classes for Evening Instruction are held at King's College from October to March, and during April, May, and June.

The Classes include one for the Elements of Chemistry and one for Practical Chemistry.

The fee for the former is £1 11s. 6d.; for the latter £2 2s. The Classes meet twice a week.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN.

17, BLOOMSBURY SQUARE, W.C.

School of Pharmacy. The session (1869-70) will commence on Friday, October 1st, and extend to the end of July.

LECTURES ON CHEMISTRY AND PHARMACY, BY DR. REDWOOD.

These Lectures will be delivered on Monday, Tuesday, and Wednesday mornings, at 9 o'clock, commencing on Monday, October 4th.

Part 1.—Physics in relation to Chemistry and Pharmacy.
,, 2.—Chemistry of Inorganic Bodies.
,, 3.—Chemistry of Organic Bodies.

Also Lectures on Botany and Materia Medica, by Professor Bentley. The first and second parts of this course,

extending over the winter months, will be delivered at 17, Bloomsbury Square, on Friday and Saturday mornings, at 9 a.m., commencing on Friday, October 1st. The third part of the course, on Systematic Botany, will be delivered at the Royal Botanic Gardens, Regent's Park, at 8 a.m.

Fees.—For registered apprentices and associates of the Society' for either of the above courses, £1 1s.; for either part separately, 10s. 6d. For those not connected with the Society, £2 2s. for either of the above courses; £1 1s. for either part separately. Students have free admission to the Library and Museum.

Laboratory.—The suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry will be opened on Friday, the 1st of October, under the direction of Professor Attfield, Ph.D. Fee for the entire session of ten months, Twenty-five Guineas. The Laboratories are open from 9.30 a.m. till 5 p.m. Students can enter at any period during the session.

Two Scholarships (the Jacob Bell Memorial Scholarship) of Thirty Pounds a year each, are open to competition annually in July.

The Board of Examiners meet monthly, and are required by the Pharmacy Act to examine "all candidates who may present themselves for examination in their knowledge of the Latin Language, in Botany, in Materia Medica, in Pharmaceutical and General Chemistry, and to grant Certificates of Competency.

CITY OF LONDON COLLEGE, LEADENHALL STREET, E.C.

The Annual Courses consist of three terms, each averaging ten experimental lectures; fee, 5s. per term. Subjects:—Junior Class, Chemistry—first year, Non-Metals; second year, Metals and (time permitting) Elements of Organic Chemistry. Senior class, 7 to 8 p.m., Practical Analysis.

LADIES' MEDICAL COLLEGE, FITZROY SQUARE.

The Course of Lectures on Elementary Chemistry, by Mr. John Newlands, F.C.S., will commence on Tuesday, October 5th, at 4 p.m., and be continued on successive Tuesdays at the same hour. Ladies will be admitted to the first lecture on presenting their cards at the College. Further particulars may be obtained on application to the Lady Secretary, at 4, Fitzroy Square.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION.

EVENING CLASSES.

Chemistry.—Mr. G. Chaloner. Tuesday, 8 to 9.

NEW KENNINGTON INSTITUTE.

Evening Lectures and Practical Classes in Chemistry, under the direction of Dr. Muter.

POLYTECHNIC INSTITUTION.

Course of Thirty Lessons in Inorganic Chemistry, by Mr. G. F. Downar, under the superintendence of Professor Pepper. Tuesday, 8.30 to 10 p.m.

ROYAL VETERINARY COLLEGE, CAMDEN TOWN.

Chemical Professor.—Mr. R. V. Tuson.

LECTURES AT LONDON MEDICAL SCHOOLS.

ST. BARTHOLOMEW'S HOSPITAL & MEDICAL COLLEGE.

WINTER SESSION.

Lecturers.—William Odling, M.B. Lond., F.R.S., Fellow of the Royal College of Physicians, Fullerian Professor of Chemistry at the Royal Institution, and Dr. Matthiessen, F.R.S. Monday, Wednesday, and Friday, at 10 a.m. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. Matthiessen, F.R.S. One course, £2 2s.

CHARING CROSS HOSPITAL AND COLLEGE.

WINTER SESSION.

Lecturer.—Mr. C. W. Heaton, F.C.S. Monday, Wednesday, and Friday, at 10. One session, £5 5s.

The Laboratory is open daily.

SUMMER SESSION.

Practical Chemistry.—Mr. Heaton, F.C.S. Monday, Wednesday, and Friday. One session, £2 2s.

ST. GEORGE'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. H. M. Noad, F.R.S. Tuesday, Thursday, and Saturday, at 11.30. One course, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Dr. Noad, F.R.S. Daily, at 10. One course, including the use of apparatus and materials, £4 4s.

GUY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. Alfred Taylor. Tuesday, Thursday, and Saturday, at 11. One course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Dr. Stevenson. Monday, Wednesday, and Friday, from 10 to 1. One course, £4 4s.

LONDON HOSPITAL.

Introductory Lecture on October 1st by C. Meymott Tidy, M.B., C.M., F.C.S., Lecturer on Chemistry at the Medical College.

Lecturers on Chemistry.—Henry Letheby, M.B., and C. Meymott Tidy, M.B.

The subjects of this course are Physics in their relation to Chemistry and Chemistry Proper. They are alternately made the chief subjects of the course, so that pupils who are studying for the Universities, may, in the period of two Winter Sessions, obtain a full course of Lectures on each subject.

The Lectures are delivered on Monday, Wednesday, and Friday, at 10·30 a.m.

Dr. Tidy has special classes for those reading for the Universities.

Practical Chemistry.—During the Summer Session, Dr. C. Meymott Tidy will deliver a short course of Lectures on Acoustics, in connection with a course on Diseases of the Ear, by Mr. Walter Rivington, M.S., Senior Assistant Surgeon, Lecturer on Anatomy, and Dean.

ST. MARY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. W. J. Russell, F.C.S. Monday, Tuesday, Thursday, and Friday, at 10.15. £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. W. J. Russell, F.C.S. Tuesday and Thursday, at 11.30 a.m.; and Saturday, at 9 a.m. One session, £3 3s.

MIDDLESEX HOSPITAL.

WINTER SESSION.

Lecturers.—Mr. Taylor and Mr. Heisch. Monday, Wednesday, Friday, and Saturday, at 11. One session, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Mr. Taylor and Mr. Heisch. Monday, Wednesday, and Friday, at 11. One session, £3 3s.

ST. THOMAS'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. J. Bernays. Tuesday, Thursday, and Saturday, at 11. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. J. Bernays. Tuesday and Thursday, 10 to 12; Friday, 11; Saturday, 10 to 1. One course, £3 3s.

WESTMINSTER HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 3 p.m.; Friday, at 3.30 p.m. One course, £5.

SUMMER SESSION.

Practical Chemistry.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 10 a.m. One course, £2.

PRIVATE TEACHERS OF CHEMISTRY IN LONDON.

Mr. J. C. Braithwaite, 54, Kentish Town Road, N.W.—Chemistry and Toxicology, Monday and Thursday; Latin, Tuesday and Friday; Botany and Materia Medica, Wednesday and Saturday. All the classes commence at 8 p.m. Laboratory open daily, except Saturdays.

Mr. Henry Matthews, F.C.S.—Laboratory, 60, Gower Street, Bedford Square. Instruction in all branches of Practical Chemistry, particularly in its application to Medicine, Agriculture, and Commerce. Laboratory open daily, except Saturday, from 10 to 5; on Saturday, from 10 to 1.

Mr. A. Vacher, 20, Great Marlborough Street, Regent Street.

Mr. John Newlands, F.C.S.—Laboratory, 13, Knowle Road, Brixton, S.W. Gives practical instruction in Analysis, and prepares gentlemen for various public examinations.

Dr. John Muter, M.A.—Laboratory, 289, Kennington Road. Instruction in Practical Chemistry and Pharmacy.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—Sir B. C. Brodie, Bart., M.A., F.R.S.

Demonstrator.—E. Madan, M.A.

A commodious Laboratory is attached to the New Museum.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other Colleges, by competitive examination in Natural Science.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.

MICHAELMAS TERM.

Practical Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 1 p.m.

LENT TERM.

Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Practical Chemistry, on the same days, at 1 p.m.

EASTER TERM.

Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Practical Chemistry, on the same days, at 1 p.m.

The Chemical Laboratory of the University is open daily, from 10 a.m. till 6 p.m.; so that Students can work there at such times as may be convenient to them; and the Professor will attend to give instruction at the times above specified.

PROVINCIAL SCHOOLS.

BIRMINGHAM.—MIDLAND INSTITUTE.

Lecturer on Chemistry.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.

Practical Chemistry.—Mr. C. J. Woodward, B.Sc. Saturday, 3 to 6, and 6.30 to 9.30 p.m.

BIRMINGHAM.—QUEEN'S COLLEGE.

WINTER SESSION.

Professor of Chemistry.—Alfred Hill, M.D., Borough Analyst. Tuesday, Thursday, and Friday, at 12.

SUMMER SESSION.

Practical Chemistry.—Professor A. Anderson. Thursday, at 1 p.m.; Friday, at 2 p.m.

BRISTOL.—BRISTOL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Mr. Thomas Coomber, F.C.S. Monday, Tuesday, Wednesday, and Thursday, at 8.15. One Course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. T. Coomber, F.C.S. Daily, except Saturday, at 8 a.m. One Course, £3 3s.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

Professor of Chemistry.—A. H. Church, M.A., Oxon.

Assistant to Chemical Professor.—E. Kinch.

The Collegiate year is divided into Two Sessions. The Autumn Session commences August 9th, divides October 6th, and ends about December 16th. During each Session, the Lectures given and Practical Classes held in the Chemical department are as follows:—

1. *Inorganic Chemistry*—Thirty-six Illustrated Lectures; Ten Catechetical Lectures.
2. *Organic Chemistry.*—Thirty-six Lectures.
3. *Agricultural Chemistry.*—Twenty-eight Lectures.

1. *Chemical Manipulation.*—Twenty-eight Lessons.
2. *Qualitative Analysis.*—Thirty-six Lessons.
3. *Quantitative Analysis.*—A certain number of Lessons.

The Laboratory is also open several hours each day for advanced Students, who occupy themselves, under the direction of the Professor and his Assistant, with the Analysis of Soils, Manures, Feeding Stuffs, Waters, &c.

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.

WINTER SESSION.

Chemical Lecturer.—Mr. J. C. Brown, B.Sc., F.C.S. Tuesday, Thursday, and Friday, at 10.15. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. J. C. Brown, B.Sc., F.C.S. Monday, Tuesday, and Friday, at 10.15. One course, £3 3s.

The Laboratory is open daily, from 10 to 4.

SCHOOL OF TECHNICAL CHEMISTRY,

7, IRWELL CHAMBERS, OLD HALL STREET, LIVERPOOL.

Conducted by Mr. A. Norman Tate. Assistants—Mr. Walter Tate and Mr. Arnold Millson.

Pupils may attend at any time between the hours of 9.30 a.m. and 5 p.m. (Saturdays, 9.30 a.m. and 1 p.m.), and may work every day, or any number of days, or portion of a day in the week, and for any period most convenient to themselves.

A separate working bench is provided for each Student; and he will also be supplied with all the ordinary chemicals (with the exception of gold, silver, and platinum solutions, alcohol, ether, and similar costly reagents), books for

reference, gas, and fuel, and will be allowed the use of balances and weights, and the most substantial portions of laboratory apparatus; but he must provide himself with test tubes, beakers, and other glass vessels and apparatus of a fragile nature required in his researches.

The Course of Instruction, in addition to the ordinary chemical studies, comprises such other subjects as may be required in the prosecution of the particular branch or branches of Applied Chemistry in which the pupil is to engage; as, for example, in the case of a pupil intended for manufacturing pursuits, he would study architectural and mechanical drawing, so far as is required for the preparation of plans, &c., of chemical apparatus and manufactories, the nature and use of building materials, and the scientific principles and practical rules involved in building and constructive operations, and other scientific and practical information required in the arrangement, construction, and management of chemical manufactories, and the application of chemistry to industrial pursuits.

COLLEGE OF CHEMISTRY, LIVERPOOL.

Principal.—Dr. Sheridan Muspratt, F.R.S.E., M.R.I.A., F.C.S., &c.

Assistant.—Mr. Martin Murphy, F.C.S.

The Course of Instruction in this College is entirely devoted to Laboratory work. The term is three months, and dates from time of entrance. Fee for working six days per week, £12 12s; five days, £11 11s.; four days, £10 10s.; three days, £9 9s.; two days, £8 8s.; and one day per week, £6 6s. Hours of attendance, from 10 a.m. till 5 p.m. The students' laboratories close at 1 p.m. on Saturdays.

Medical students may enter for one hour per day per session. Fee, £3 3s.

Certificates of attendance recognised by the University and Apothecaries' Hall of London, and Apothecaries' Hall of Ireland.

LEEDS SCHOOL OF MEDICINE.

WINTER SESSION.

Lecturer.—Mr. J. Chapman Wilson, F.C.S.

Daily, except Saturday, at 11 a.m. One course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Mr. Wilson, F.C.S.

Tuesdays and Thursdays, 11 to 12.30. One course, £2 2s.

LEEDS MECHANICS' INSTITUTION AND LITERARY SOCIETY'S LABORATORY.

SESSION 1869-70.

Chemical Classes for Instruction in Elementary, Practical, and Analytical Chemistry.

Teacher.—Mr. George Ward, F.C.S.

The usual Sessional Course of Instruction in abstract and Applied Chemistry will commence on Thursday, September 23rd, at 8 p.m., on which evening the teacher of the classes will introduce the general subject in a Lecture explanatory of its principles, of the mode in which these should be studied, and also of the plan which he purposes to adopt in conducting the classes during the session.

Fees, payable in advance:—Elementary Chemistry, Thursday, per session, £1 15s.; or 5s. 6d. per month. The subscription includes a selection of apparatus and material specially adapted for the course of instruction. To pupils providing their own materials, £1 1s. per session. Organic Chemistry, Friday, per session, 10s. 6d. Practical Chemistry, Tuesday, per session, £1 1s.; or 3s. 6d. per month. including apparatus and material. The session extends over seven months, from October to April inclusive.

HIGH HARROGATE COLLEGE, YORKSHIRE.

Professor of Chemistry.—W. G. Mason, F.C.S., Certificated Science Teacher.

MANCHESTER GRAMMAR SCHOOL.

DEPARTMENT OF MATHEMATICS AND PHYSICAL SCIENCE.

Masters.—T. S. Aldis, M.A. (Cantab.), W. M. Watts, D.Sc. (Lond.); J. Angell Esq.

There is a large Chemical Laboratory attached to the School, and Chemistry and the various branches of Physics are regularly taught. Arrangements can be made for students to devote their whole time to Physical Science and Mathematics.

MANCHESTER ROYAL SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Mr. Daniel Stone.

The usual course for the Medical Boards.

A Laboratory is connected with the school.

OWEN'S COLLEGE, MANCHESTER.

(IN CONNECTION WITH THE UNIVERSITY OF LONDON.)

Chemistry.—Professor H.E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.,

Junior Class.—Wednesday and Saturday, from 9·15 to 10·15 a.m.

Subject: Inorganic Chemistry, comprising the laws of chemical combination, and a description of the properties and mode of preparation of the non-metallic elementary bodies and their most important compounds.

Senior Class.—Tuesday and Thursday, from 9.15 to 10.15 a.m.

Subjects: Inorganic and Organic Chemistry, including the properties of the metals and their compounds, and the composition and relations of the best defined groups of organic bodies, and the laws regulating their formation.

Students are expected to answer the written exercises and attend the *viva voce* examinations given in these classes.

Fee, for each class, £3 3s. For both classes, £5 5s.

A Recapitulatory Lecture, without additional Fee, will be given on Friday at 9.15 a.m., which members of both classes will be required to attend.

Extra Class.—Wednesday, from four to five p.m.

Subject: Technological Chemistry.

The Chemical Principles involved in the most important Chemical Manufactures will be chiefly considered in this course. The subject will be discussed as follows, and as far as time will permit.

1. Production of Heat—Heat of Combustion—Combustibles—Coal.
2. Production of Light—Coal Gas—Meaurement of Illuminating Power of Coal Gas—Distillation of Coal.
3. Water and Air, as regards their Sanitary and Technological Relations.
4. Processes concerned in the manufacture and application of the Alkalies.
5. Dyeing and Calico Printing.
6. Manufacture of Acids.
7. Manufacture of Glass and Porcelain.

Students attending this class must be acquainted with the principles of Chemical Science. Fee, £2 2s.

Analytical and Practical Chemistry.

LABORATORY COURSE.

Professor.—Henry E. Roscoe B.A., Ph.D., F.R.S.

Senior Assistant.—Mr. C. Schorlemmer, F.C.S.

Junior Assistant.—Mr. T. E. Thorpe, Ph.D.

The aim of this course is to make the student practically acquainted with Chemical Science, to enable him to conduct analysis and original research, and to fit him for applying the science to the higher branches of Art, Manufactures, and Agriculture. To accomplish this, an attendance of not less than four days per week during three whole sessions is as a rule necessary. It is very advisable that each Laboratory Student should attend or should have attended the course of Lectures on Theoretical Chemistry.

The College Laboratory will be open for students daily from 10.30 a.m. until 5 p.m., except Saturdays, when it will be closed at 1.30. The Laboratory is closed from 1.15 until 2, for dinner.

The Laboratory is fitted with every convenience for the prosecution of practical chemistry, all branches of qualitative and quantitative analysis, and original research.

Each student is provided with a separate working table, set of tests, fuel, water, and gas, free of expense; but he is required to find his own apparatus, a few of the more expensive reagents, and the chemicals required for his experiments. Other apparatus or instruments of a more expensive description may be obtained on loan from the Laboratory Steward, subject to regulations to be prescribed by the Professor.

Fees for the Session.—Students working six days per week, £21; ditto, four days, £17 17s.; ditto, three days, £13 13s.; ditto, two days, £9 9s.; ditto, one day, £5 5s. Students entering the Laboratory Class at or after Christmas, for not less than two days per week, will be charged two-thirds of the fees for the whole session.

Special Fees for Shorter Periods.—For six months, six days per week, £17 17s.; five months, ditto, £15 15s.; four months, ditto, £13 13s.; three months, ditto, £10 10s.; two months, ditto, £7 7s.; one month, ditto, £4 4s.

Lectures on the methods of Qualitative and Quantitative Analysis, intended to supplement the instruction in Practical Chemistry, will be given by Mr. Schorlemmer, on Mondays, from 4 to 5 p.m.

First year's Laboratory Students are recommended to attend and answer the written exercises and the *viva voce* questions given in this class. Fee, £1 11s. 6d.

Chemical Calculations.—In this class, instruction and special practice is given, by Mr. Schorlemmer, on Wednesday, from 4 to 5 p.m., in the methods of Chemical Calculations, serving as supplementary to the Lecture and Laboratory Courses. Fee, £1 1s.

The Lectures on Chemistry in Owen's College are recognised by the University of London for its Medical Degrees, by the Royal College of Surgeons, and by the Apothecaries' Hall.

EVENING CLASSES.

Chemistry.

Professor H. E. Roscoe, B.A., Ph.D., F.R.S.

Lecture Class (First Course—The Non-Metallic Elements).—Monday, from 8.35 to 9.35 p.m.

Lecture Class (Second Course—The Metals).—Mr. T. E. Thorpe, Ph.D. Friday, from 8.35 to 9.35 p.m.

Lecture Class (Third Course—Organic Chemistry).—Mr. C. Schorlemmer, F.C.S. Friday, from 7.30 to 8.30 p.m.

Laboratory Courses of Practical Chemistry.

Professor Roscoe, F.R.S., and Mr. Schorlemmer, F.C.S.

Junior and Senior Divisions.—Monday, from 6 to 8.30 p.m.

Pharmaceutical Course.—Monday from 6 to 8.30 p.m.

COLLEGE OF MEDICINE, NEWCASTLE.

(IN CONNECTION WITH THE UNIVERSITY OF DURHAM).

Education in Pharmacy.—The Council of the College have added a Lectureship on Pharmacy to those at present existing. The proposed curriculum for Students in Pharmacy will consist of attendance on Lectures on Botany, Materia Medica, Chemistry, and Pharmacy. The Lectures on the two former of these subjects will be delivered in the summer, and those on the two latter in the winter session of study.

Lecturer on Chemistry.—Mr. A. Freire-Marreco.

Monday, Wednesday, Thursday, and Friday, at 4 p.m.

EVENING COURSES.

Chemical Physics.—Every Monday, at 7.30 p.m.

Inorganic Chemistry.—Every Wednesday, at 7.30 p.m.

Practical Pharmacy.—B. S. Proctor. Every Tuesday, at 7.30 p.m.

This course will include—General Processes and Physics applied to Pharmacy—Pharmacopœial Processes, and the most important recent improvements in Pharmaceutical preparations—Dispensing operations—Testing and the Test Solutions of the Pharmacopœia. The course will be illustrated, whenever practicable, with apparatus, experiments, and processes in operation.

Practice of Chemistry.—The Laboratories are open daily throughout the year from 10 to 5 o'clock. Non-Medical students can attend Laboratory practice and receive Instruction in Analysis.

Students attending the Laboratory practice and Lectures on Chemistry, who have passed the Durham Registration Examination, or any Examination in Arts recognised as its equivalent, will be registered on the books of the College as Matriculated Students in Chemistry.

Fees.—Perpetual ticket for Pharmacy Course, £6 6s (this applies only to Students at present engaged in Pharmacy, and who enter before October, 1871). Separate Courses of Lectures (each), £4 4s. Laboratory Practice, 6 days per week—Three months' ticket, £9 9s; six months' ticket, £16 16s.; twelve months' ticket, £31 10s. Special arrangements for shorter attendances. These fees admit to all the courses in Chemistry. For a certificate in Chemistry, 10s.

SHEFFIELD.

Mr. W. Baker, F.C.S. Laboratory for Theoretical and Practical Chemistry, 46, High Street, Sheffield.

SCHOOL OF CHEMISTRY,

1, SURREY STREET, SHEFFIELD.

Mr. A. H. Allen, F.C.S., delivers a Course of Thirty Lectures on Inorganic Chemistry, in connection with the Science and Art Department.

Day and Evening Classes for Analytical Chemistry.

SHEFFIELD SCHOOL OF MEDICINE.

During the Winter Session, Mr. A. H. Allen, F.C.S., will deliver a Course of Forty-five Lectures on Chemistry.

SCOTLAND.

UNIVERSITY OF EDINBURGH.

Professor of Chemistry.—Dr. A. Crum Brown, F.R.S.

ROYAL COLLEGE OF PHYSICIANS AND SURGEONS, EDINBURGH.

Lecturer on Chemistry.—Dr. Stevenson Macadam, F.R.S.E.

The Courses of instruction in Chemistry include its applications to Medicine, Agriculture, and the Industrial Arts; and they qualify for the University of Edinburgh, and other Universities; the Royal Colleges of Physicians and Surgeons, the Navy, Army, and Indian Medical Service, and the other Medical and Public Boards.

The Lectures on Chemistry commence on Wednesday, November 3rd, and continue to be delivered daily during the five months of the Winter Session. The Lectures form a complete Course; the New Nomenclature and Notation are employed throughout, and special Lectures in Technological Chemistry are given. Tutorial Class Examinations are held during the Session, and Excursions are arranged for visiting the principal Chemical Manufactories.

The Instructions in Analytical Chemistry are conducted in the Laboratories at Surgeons' Hall, which are now open daily, under the personal superintendence of Dr. Macadam, for the instruction of gentlemen in Chemical Analysis, and the prosecution of researches in Manipulative Chemistry.

The Prelections in Practical Chemistry are also conducted in the Laboratories at Surgeons' Hall. The subjects

selected for Examination are those with which Medical Students are specially called upon to exhibit a practical acquaintance.

Fees.—Lecture, £3 5s. (University Graduation, £4 4s.); Practical Chemistry (University, &c.), £3 3s.; Analytical Chemistry, £2 per month, £5 for three months, or £10 for six months.

ANDERSONIAN UNIVERSITY, GLASGOW.

Professor of Chemistry.—Dr. Penny, F.R.S.E., F.C.S., &c.

1. Systematic Course of Lectures and Demonstrations on Chemistry, for Medical Students, Manufacturers, Civil Engineers, Agriculturists, &c. Daily, except Saturday, from 12 to 1, commencing 27th of October and terminating in April, £2 2s.

The object of this Course, which comprises upwards of 100 Lectures, is to convey to the student a thorough knowledge of the principles of Chemistry, and the applications of the science to Medicine, Manufactures, Agriculture, &c.

Certificates of attendance on these Lectures are received by the Royal College of Physicians of London and Edinburgh; by the Royal Colleges of Surgeons of England, Ireland, and Edinburgh; by the Faculty of Physicians and Surgeons of Glasgow; by the Army, Navy, and East India Boards; and by the Apothecaries' Halls. They also qualify for Graduation in the University of London, &c.

2. Instruction in the various branches of Practical Chemistry, and Analysis in the Laboratory. Daily, from 10 to 4.

After the usual preparatory training, the attention of the Student is specially directed to the examination and analysis of Minerals, Products of Commerce and Manufacture, Manures, &c., and, when desired, to Original Research.

3. The Private Laboratory for Commercial and Mineral analyses and assays, and for consultations and special investigations. Open daily, from 10 to 5, throughout the year.

4. Evening Course of Popular Lectures on the General Principles of Chemistry, and its application to the various branches of the Useful Arts. On Fridays, at 8.30.

Students attending this Course have the privilege of competing for the Prizes and Certificates offered by the Society of Arts, and the Government Department of Science and Art.

5. Evening Course of Instruction in Practical Chemistry and Analysis. On Thursday, from 7 to 9.

6. Summer Course of Practical Chemistry for Medical Students. Three months, commencing in May, £2 2s.

Young's Chair of Technical Chemistry.—This new Chair, which has been founded by Mr. James Young in connection with the Andersonian University, has been accepted by Mr. W. H. Perkin, F.R.S. We hear that the Laboratory will be opened in January next, and will accommodate about forty students.

UNIVERSITY OF GLASGOW.

Professor of Chemistry and Practical Chemistry.—Dr. Thomas Anderson, F.R.S.E.

GLASGOW MECHANICS' INSTITUTION.

Lecturer on Chemistry.—Dr. R. Carter Moffat.

1. Course of six months morning Lectures, qualifying for the various Medical Examinations, and also suited to the requirements of Manufacturers, Civil Engineers, &c. Daily, at 10. Begin 25th October.

2. Day and Evening Experimental Classes are held in the Laboratory, by Dr. R. Carter Moffat. Hours, from 10 till 4, and 7 till 9.

In these Classes, Students are instructed individually, and not as members of a class, so that every facility is given for the thorough attainment of the various principles and methods in Analysis, &c. Students may enter at any time; and the Classes are suitable for beginners as well as for advanced pupils. All are supplied with Apparatus, &c., and they personally perform their own Experiments. Those desiring it may take up, on entering, any department they choose—as, for example, the Analysis of Substances for Trade purposes, or investigations relative to the Improvement of certain Manufacturing Processes, and the Discovery of New Materials useful in the Arts, &c.

3. Popular Evening Lectures, every Monday, at 8.30, for six months.

4. Medical Students' Practical Class in Summer, commencing May 3rd. £2 2s.

GLASGOW VETERINARY COLLEGE.

Professor of Chemistry and Materia Medica.—Dr. R. Carter Moffat.

The Session will commence on Monday, October 25th, 1869.

IRELAND.

DUBLIN.—TRINITY COLLEGE.

Professor of Chemistry.—Dr. Apjohn, F.C.S.

The Lectures will commence on Wednesday, November 2nd, at 2 o'clock, and be continued each Tuesday, Thursday, and Saturday.

ROYAL COLLEGE OF SURGEONS, DUBLIN.

Professor of Chemistry.—Dr. Barker.

The Professor receives operating pupils into the Chemical Laboratory.

QUEEN'S COLLEGE, BELFAST.

Professor of Chemistry.—Dr. Andrews.

QUEEN'S COLLEGE, CORK.

Professor of Chemistry.—Dr. Blyth.

QUEEN'S COLLEGE, GALWAY.

Professor of Chemistry.—Dr. T. H. Rowney.

A Laboratory for Practical Instruction is attached to all the Queen's Colleges. The usual Practical Course for the Medical Boards is given in the summer.

ROYAL COLLEGE OF SCIENCE FOR IRELAND, STEPHEN'S GREEN, DUBLIN.

This College supplies, as far as practicable, a complete course of Instruction in Science, applicable to the Industrial Arts. The Subjects of Instruction are:—Pure and Applied Mathematics, Descriptive Geometry and Mechanical Drawing, Mechanism, Theoretical and Applied Chemistry, Chemical Analysis, Physics, Botany, Zoology, Geology and Paleontology, Mineralogy, Mining, Machinery, Surveying, and Agriculture.

Professor of Theoretical Chemistry.—W. K. Sullivan, Ph.D., V.P.R.I.

Professor of Analytical and Applied Chemistry.—R. Galloway, F.C.S.

Assistant Chemist.—Wm. Plunkett, F.C.S.

A Course of Lectures on Inorganic and Organic Chemistry is delivered by Dr. Sullivan three times a week during the session. Fee for the entire course, £2.

A Course of Lectures on Technological Chemistry is delivered by Mr. Galloway twice a week during the session. Fee for the course, £2.

The Chemical and Metallurgical Laboratories, under the Direction of Mr. Galloway, are open every week day during the session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical research. Each student is taught, not in class, but separately and independently; and he is supplied with a separate working table, with reagents, fuel, water,

gas, and the larger and more expensive apparatus. Fee, for the session of nine months, £12; or for three months, £5; or for one month, £2.

Students have access to the extensive Library of scientific books in the College, and have the privilege of borrowing the books.

There are four Royal Scholarships, of the value of £50 each, yearly, with free Education, including Laboratory Instruction, tenable for two years; two become vacant each year; they are given to students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with free Education, including Laboratory Instruction, tenable for three years; three become vacant each year. These are awarded at the annual May Examinations of the Science and Art Department.

A Diploma of Associate of the College is granted at the end of the three years' Course.

The Session commences on Monday, October 4th.

ON SPIRIT MADE FROM RICE.

By JAMES BELL, Esq.

THERE has always been a difficulty experienced in producing from rice a spirit free from a pungent odour. An impression prevailed that the pungency was due to the presence of some compound ether generated during the process of fermentation; but how or why it was produced in the fermentation of a saccharine extract prepared from rice, and not in that obtained in the ordinary way from other materials, was a problem which appeared difficult of solution.

In the course of manufacture of spirit from rice, sulphuric acid is the agent employed for converting the starch of the rice into glucose, and this process is conducted in a close wooden vessel under steam pressure at a temperature ranging from 216° to 230° Fahr. It has been observed that when the process of saccharisation was conducted at a temperature approaching 230°, the spirit obtained was more pungent than if the lower temperature had been observed. It has also been remarked that the pungency of the spirit was less in proportion as the rice was purified or freed from the husk.

Being desirous to investigate this subject, I undertook the examination of a sample of rice spirit which was placed at my disposal, and which had been made from rice that had been only partially freed from the husk, and though it appeared that the temperature during the process of saccharisation was maintained at about 216° Fahr., the spirit was very pungent.

The spirit was found, on the application of a slight heat, to freely reduce ammoniacal nitrate of silver, but without depositing the metal in a specular form; and a very small quantity sufficed to instantly decompose a solution of a permanganate.

When a portion of the spirit was treated in the cold with caustic potash and allowed to stand for a few hours, the pungency rapidly disappeared, and there was simultaneously produced a dark brown resinous substance soluble in alcohol and ether. The spirit recovered by distillation from the alcoholic alkaline solution was free from acrid odour, and gave the normal reaction with the mercury compounds for ethylic alcohol.

The addition of a very small quantity of the acid sulphite of sodium to the spirit, rapidly destroyed the pungent odour, and the alcohol obtained afterwards by distillation was unobjectionable in quality.

These reactions, it will be seen, pointed directly to the presence of an aldehyde, and in order to identify it, a portion of the spirit was introduced into a stoppered bottle, and treated in the cold with moist oxide of silver and left in contact therewith for several days. At the end of this time, there was a slight deposit of the metal on the glass, as well as other evidence that a quantity of the oxide had been reduced. To obtain the oxidised product, the excess of oxide of silver was removed by filtration and the silver salt in solution exactly decomposed with hydrochloric acid. The precipitate of chloride of silver was then filtered off, and the liberated acid neutralised with baryta and the spirit distilled. The distillate obtained was destitute of pungent odour, and the spirit was commercially pure.

The baryta salt which formed the residue in the retort was decomposed with sulphuric acid, and the liberated organic acid separated from the insoluble sulphate by distillation. The acid thus obtained proved to be acrylic, which had been produced from acrylic aldehyde by oxidation, and consequently, it was to the presence of this aldehyde that the pungent odour of the spirit was due.

There can hardly be a doubt that it is during the process of saccharisation that the fatty substances contained in the rice are decomposed; and that the acrolein is immediately thereupon produced by the action of the sulphuric acid upon the glycerine; and this view would seem to be borne out by the fact stated above, that a variation in the steam pressure in conducting the process of saccharisation affected the quantity of the acrolein produced.

It is well known that fats in a state of emulsion are in a condition to be readily acted upon by chemical reagents and to be decomposed, and it is not improbable that the conditions in this case are favourable to the action of the sulphuric acid upon the fatty substances in the rice, and in effecting their decomposition.

A sample of the rice from which the spirit was prepared was found to contain 0·62 per cent of fats, and assuming that the whole of the glycerine contained therein was converted into acrylic aldehyde, and that 65 per cent of starch was actually utilised in the production of ethylic alcohol, every thousand grains of the latter would contain one grain and a-half of the aldehyde.

The fact has long been known that rice spirit contained some compound which possessed the property, like acetone, of dissolving and keeping in solution certain compounds of mercury which are insoluble in pure alcohol and in water; and that before the absence of wood naphtha in rice spirit could be established by the ordinary chemical tests, it was necessary to distil the spirit once or twice from caustic potash.

The sample of rice spirit in question possessed the property of preventing the precipitation of the mercury compounds in an eminent degree, but the spirit after the complete separation of the acrylic aldehyde gave the normal reaction for pure alcohol.

To test the solvent power of acrolein for the mercury compounds, a small quantity of the aldehyde was prepared, and it was found to possess the property of preventing the precipitation of the ammonium compound of iodide of mercury in an alkaline solution, to nearly the same extent as acetone; and a very minute quantity of it was sufficient to impart a pungent odour to pure alcohol, similar to that possessed by the rice spirit.

MISCELLANEOUS.

Artificial Light.—The German chemist Landsberg says that artificial light contains 90 per cent of calorific rays, while sunlight contains only 50. To the number of these rays he attributes the disagreeable sensation produced upon the eyes by artificial light. By passing it through alum or mica, the calorific rays are interrupted, and the light rendered more agreeable and less injurious.

The Humboldt Centenary.—On the 14th of September, 1769, was born Alexander von Humboldt. According to the *Moniteur Belge* of this date, 1869, there is a plan on foot at Berlin to found and establish a Humboldt Palace, wherein would be united together the libraries of all the literary and scientific societies existing at Berlin, all of which would have their meeting rooms in that palace also.

St. Bartholomew's Hospital and College.—

The Winter Session will commence on Friday, October 1.

Students can reside within the Hospital walls, subject to the College Regulations.

For all particulars, concerning either the Hospital or College, application may be made, personally or by letter, to Mr. Morrant Baker, the Resident Warden; or at the Museum or Library.

St. Bartholomew's Hospital and College.—

CLASSES for the UNIVERSITY OF LONDON.

MATRICULATION EXAMINATION.

There will be Two Classes held at St. Bartholomew's Hospital in each year, for the convenience of gentlemen preparing for the Matriculation Examination at the London University—from October to January, and from March till June. Provision will be made for teaching all the subjects required, as follows:—

(1) Classics, French, English, Modern Geography, and English History—Malcolm Laing, M.A., Trinity College, Cambridge.
(2) Mathematics and Natural Philosophy—P. J. Hensley, M.D., Cantab., Fellow of Christ's College, Cambridge, Tutor to the Hospital.
(3) Chemistry—A. Matthiessen, F.R.S., Lecturer on Chemistry to the Hospital.

Fee for the Course of Three Months .. 10 guineas.
Fee for (1) or (2) .. .. 5 guineas.
Fee for (3) .. .. 2 guineas.

PRELIMINARY SCIENTIFIC EXAMINATION.

A Class in the subjects required for the preliminary Scientific Examination will be held from January to July, and will include all the subjects required, as follows:—

Chemistry—A. Matthiessen, F.R.S.
Botany—Rev. G. Henslow, M.A., Cantab., F.L.S., Lecturer on Botany to the Hospital.
Zoology and Comparative Anatomy—W. S. Church, M.D. Oxon., Lecturer on Comparative Anatomy to the Hospital; late Lee's Reader in Anatomy at Christchurch, Oxford.
Mechanical and Natural Philosophy—P. J. Hensley, M.D., Cantab.

Fee to Students of the Hospital .. .. 6 guineas.
Fee to others .. .. 10 guineas.
Fee for any single subject .. .. .. 3 guineas.

Further information may be obtained on application, personally or by letter, to the Resident Warden of the College, St. Bartholomew's Hospital.

University of Aberdeen.—Chancellor, His

Grace the Duke of Richmond. *Vice-Chancellor and Principal*, the Very Rev. P. C. Campbell, D.D. *Lord Rector*, M. E. Grant Duff, M.A., M.P.

FACULTY OF MEDICINE—SESSION 1869-70.

WINTER SESSION, Commencing on Wednesday, October 27.

Anatomy—Professor Struthers, M.D. 11 a.m. £3 3s.
Practical Anatomy and Demonstrations—Professor Struthers and the Demonstrator. 9 to 4, and 2 p.m. £2 2s.
Chemistry—Professor Brazier. 3 p.m. £3 3s.
Institutes of Medicine—Professor Ogilvie, M.D. 4 p.m. £3 3s.
Surgery—Professor Pirrie, C.M., F.R.S.E. 10 a.m. £3 3s.
Practice of Medicine—Professor Macrobin, M.D. 3 p.m. £3 3s.
Midwifery and Diseases of Women and Children—Professor Inglis, M.D. £3 3s.
Zoology, with Comparative Anatomy—Professor Nicol, F.G.S. 2 p.m. £3 3s.
Medical Logic and Medical Jurisprudence—Professor Ogston, M.D. 9 a.m. £3 3s.

SUMMER SESSION, Commencing on the First Monday of May.

Botany—Professor Dickie, M.D. 9 a.m. £3 3s.
Materia Medica (100 Lectures)—Professor Harvey, M.D. 3 and 4 p.m. £3 3s.
Practical Anatomy and Demonstrations—Professor Struthers and the Demonstrator. 9 to 4, and 2 p.m. £2 2s.
Practical Chemistry—Professor Brazier. 10 a.m. £3 3s.
Zoology, with Comparative Anatomy—Professor Nicol. 11 a.m. £3 3s.

Matriculation Fee (including all dues) for the Winter and Summer Sessions, £1. For the Summer Session alone, 10s.

Royal Infirmary—Daily, at Noon. Perpetual Fee to Hospital Practice, £6; or, first year, £3 10s., second year, £3.

Clinical Medicine—Drs. Harvey and Smith. £3 3s.
Clinical Surgery—Drs. Keith and Pirrie. £3 3s.

General Dispensary, and Lying-in and Vaccine Institution—Daily. Eye Institution—Daily. Royal Lunatic Asylum—Clinical Instruction is given for Three Months in the year.

The Regulations relative to the Registration of Students of Medicine, and the Granting of Degrees in Medicine and Surgery, may be had of Dr. Macrobin, Dean of the Faculty of Medicine.

Full information regarding the Classes and Degrees in the Faculties of Arts, Law, and Divinity, and in regard to Bursaries and Scholarships, will be found in the University Calendar, published by Messrs. Wyllie and Son, Union Street Aberdeen, by post, 1s. 8d.

Medical Education.—St. Mary's Hospital

MEDICAL SCHOOL, Paddington, will open on October 1st, 1869. In addition to the usual courses, special instruction is provided in Operative Minor Surgery and Bandaging, Ophthalmic, Aural, and Dental Surgery, Comparative Anatomy, Histology, and Pathology; all of which are taught practically by demonstration as well as lecture. For prospectus, apply to

W. B. CHEADLE, M.D., Dean of the School.

St. George's Hospital Medical School.—

The WINTER SESSION will commence on Friday, 1st October, with an Introductory Address by Dr. WADHAM, at 2 p.m., in the Hospital.

Consulting Physicians—Dr. Wilson, Dr. Bence Jones, Dr. Pitman.
Physicians—Dr. Fuller, Dr. Barclay, Dr. John Ogle, Dr. Wadham.
Assistant-Physicians—Dr. Dickinson, Dr. William Ogle.
Physician-Accoucheur—Dr. John Clarke.
Consulting-Surgeons—Mr. Cæsar Hawkins, Mr. Cutler, Mr. Tatum.
Surgeons—Mr. Hewett, Mr. Pollock, Mr. Henry Lee, Mr. Holmes.
Assistant-Surgeons—Mr. Rouse, Mr. Pick.
Ophthalmic Surgeon—Mr. Henry Power.
Orthopædic Surgeon—Mr. Brodhurst.

A Maternity Department and Departments for Ophthalmic and Dental Surgery are arranged in connection with the Hospital School.

LECTURERS.

Descriptive and Surgical Anatomy—Mr. Rouse.
Physiology and General Anatomy—Dr. Wm. Ogle.
Chemistry—Dr. Noad, F.R.S.
Medicine—Dr. Barclay.
Psychological Medicine—Dr. Blandford.
Surgery—Mr. Holmes.
Ophthalmic Surgery—Mr. Power.
Orthopædic Surgery—Mr. Brodhurst.
Operative Surgery—Mr. Rouse.
Pathology and Morbid Anatomy—Dr. John Ogle.
Midwifery—Dr. John Clarke.
Materia Medica—Dr. Dickinson.
Forensic Medicine—Dr. Wadham.
Dental Surgery—Mr. Vasey.
Botany—Mr. Child, F.L.S.

Clinical Lectures by the Physicians and Surgeons every week.

A Medical Tutor is appointed to superintend the studies of the pupils, and hold periodical examinations.

On payment of one hundred guineas at entrance, a Pupil becomes perpetual to the Hospital Practice and all the Lectures.

Compounders pay forty guineas on admission, forty guineas for the second year, and ten guineas for each subsequent year, until their payments shall have reached one hundred and ten guineas, when they become perpetual pupils.

Gentlemen may enter separately to Medical or Surgical Practice, or to any single course of Lectures.

Dental pupils are admitted on payment of £45.

The Pupils attending the Practice of the Hospital will be divided into classes among the Physicians and Surgeons in rotation, and each of them will be required to act as Clinical Clerks and Dressers to the Medical Officer to whom they are attached.

Special Demonstrations of Skin Diseases and Lectures on Public Health will form part of the course of Lectures on the Practice of Medicine; and Students will be required also to attend the separate courses of Lectures on Pathology and on Psychological Medicine.

In connection with the Lectures on Surgery, Demonstrations will be given on the Use of the Laryngoscope. A separate course of Lectures on Diseases of the Eye, with Demonstrations of the Use of the Ophthalmoscope, will be given, as well as Lectures on Orthopædic Surgery, with Illustrations of Deformities and their Treatment. Attendance on each of these courses will be required of Surgical Pupils.

In the Maternity Department, special Clinical Instruction will be given on Diseases peculiar to Women, and Practical Instruction in Vaccination to those who require certificates of proficiency.

House-Physicians and House-Surgeons are selected from among the senior Students according to merit, without further payment beyond a small sum paid to the Hospital for board.

The offices of Obstetric Assistant, Curator of the Museum, Medical and Surgical Registrars, and Demonstrator of Anatomy, with salaries of from £50 to £100 attached to each, are held out for competition annually. The William Brown Exhibition of £40 per annum, tenable for three years, is bestowed after a competitive examination. Clinical Prizes are offered annually by Sir Benjamin Brodie and Dr. Acland. Sir Charles Clarke's "Good Conduct" Prize; the Thompson Medal, and the Johnson Memorial Prize, are also to be competed for each year. A general examination of all the Students is held at the end of the Summer Session, and Prizes and Certificates of General Proficiency are given to the most deserving.

Further information may be obtained from Dr. Barclay, the Treasurer, or Mr. Holmes, the Dean of the Medical School, and from any of the Lecturers and Medical Officers of the Hospital.

New Kennington Institute.—The Popular

Evening Lectures and Practical Classes in CHEMISTRY will re-commence on the 1st of October, under the direction of Dr. MUTER.

Tickets to be had of W. Baxter, Hon. Sec., 182, Lower Kennington Lane.

THE CHEMICAL NEWS.

Vol. XX. No. 513.

ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

The object of the present series of articles is to place my own practice before beginners in microscopical science, for although there are a vast number of existing works on the microscope, many of them are of a popular nature and addressed to those who seek in the microscope a means of recreation rather than of scientific research. My wish is to supply simple and practical directions to aid the student, giving very much in detail such processes as are but little mentioned in books, and which are more usually learned by seeing the instrument in the hands of an experienced person; but as this is an advantage not accessible to every one, it would seem that there is still a want, which it is my hope that this and succeeding papers will help to supply, and prepare the student to consult with profit more elaborate treatises.

I have thought proper, therefore, to devote this article to the consideration of the instrument we have to work with. No workman is any the worse for a knowledge of the contents of his tool-chest; in fact, he will be far better qualified for making use of the appliances he possesses by knowing their construction.

Microscopes vary much in their details of construction, each maker having an instrument for which he claims its own especial merit. For convenience sake, the general plan of structure may be described as consisting of a tube containing the optical portion, capable of a sufficient range of motion to and from a support for the object to be examined, known as the stage, beneath which is placed a mirror, provided with the necessary adjustments for reflecting light upwards through the aperture in the stage.

The plans employed for supporting the tube containing the lenses, or "body," are two in number; in one, that adopted by Messrs. Beck and a few other makers, the body is supported by the greater part of its length, and runs in groove of peculiar form, which effectually prevents the detrimental movement known as "twist." In the other mode, the one used by Messrs. Ross, Powell and Leland, and the majority of opticians, the body is attached to the extremity of the cross-arm, the rack work moving up and down in a tube attached to the trunnions which carry the instrument between the two uprights connected with its base. This last plan of construction involves the use of a greater weight of metal and a more careful disposition of it to secure stability than where the body is supported in the former manner, but when skilfully made there is no practical objection to its employment.

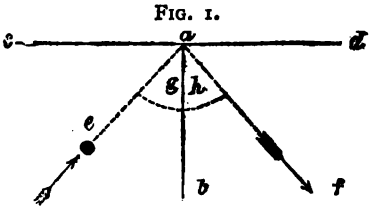
Dr. Carpenter speaks highly of the first mode, which is also approved of by Dr. Bowerbank: my experience is decidedly in its favour, my own instrument so constructed having been exposed to more than ten years' severe wear, and having had no substantial repairs during that period.

The part of the microscope I wish to direct attention to in the first instance, is the body and its contents. A combination of lenses called the object glass is screwed to the bottom of the tube, and another called the eye-piece, is placed at the top. For the sake of simplicity, the binocular arrangement will be for the present omitted, the instrument being supposed to have but a single body. In order that the use of the glasses contained in this tube may be understood, I must direct attention in the first place to some of the properties of light.

A *ray* of light, which is a very arbitrary term, may be considered, for the present purpose, as a small cylinder of light—a thing which has no real existence in nature, but will serve well for the purpose of demonstration. It is very much what the line is in mathematics.

Should this ray of light fall upon a polished surface which is not capable of allowing it to go through, or, in other words, an opaque polished surface like a bright plate of metal, *c*, *d* (Fig. 1), if the ray of light, *b*, *a*, falls upon that surface perpendicularly, it will be sent back by the same course through which it came down. On the contrary, should the ray of light *c*, *a*, fall obliquely, it will

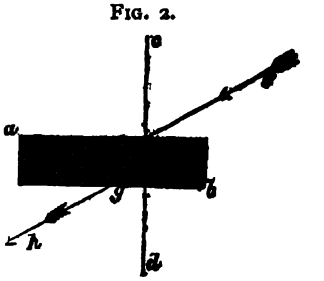
Fig. 1.



be reflected at an angle, *b*, *a*, *f*, equal to that *e*, *a*, *b*, at which it fell upon the reflecting medium. This angle of incidence, *e*, *a*, *b*, will be equal to the angle of reflection, *b*, *a*, *f*. Now this principle is made use of in our commonest means of illumination,—the mirror under the stage by which the light from a lamp or other source of light at one side or in front of the microscope, or in any other convenient place, is directed through the axis of the instrument. In the subsequent papers I shall say more about the application of the reflective principle. This is the only instance to be noticed at present.

Now, supposing that the ray of light falls upon a transparent material (a plate of glass, for example, a substance more dense than air), should the ray, *c*, *d*, fall upon this plate of glass, *a*, *b* (Fig. 2), perpendicularly,

Fig. 2.



it passes it straight through without any alteration taking place; but should the ray of light, *e*, *f*, fall obliquely, it will no longer pass through in the same direction, but will be bent towards the perpendicular,

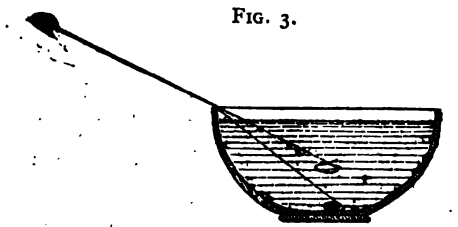
* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

c, *d*, in a greater or less degree according to the density of the medium, as at *f*, *g*, and is bent again upon its emergence into the rarer medium at *g*, towards *h*.

The amount of "refraction," as this bending is called, would be much less with water than it would be with glass, and it would be greatest of all in the diamond, other substances refracting in intermediate degrees.

The effect of refraction is familiarly illustrated by the well-known phenomenon of objects immersed in water appearing to be nearer the surface than they really are, a pool appearing to be only three or four feet deep, when in reality it is nearer six or eight. This may be readily demonstrated by placing a stick or other object in a basin of water (Fig. 3); the stick

Fig. 3.



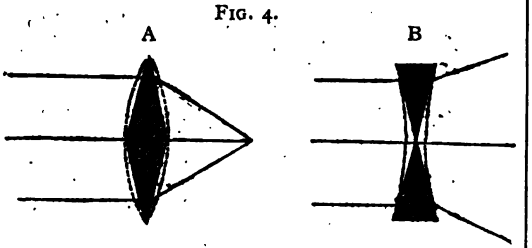
will appear bent where it enters the water; a coin or other object will appear to be at a much less depth than it actually is.

It is owing to refraction that we are able to make use of lenses, which give us the power of bending rays of light and turning them about in any way that may be required.

Lenses are circular pieces of glass or other transparent material capable of refracting light, and having curved surfaces, either convex or concave.

The action of a lens upon a ray of light will be best understood by reference to Fig 4. For the sake of

Fig. 4.



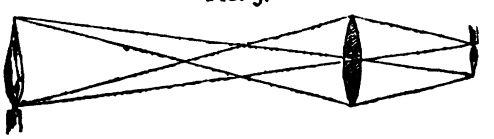
simplicity the dotted curved lines representing the section of the lenses may be considered as straight lines, as shown in the diagram.

It has been shown (Fig 2) that when a ray falls obliquely it is refracted, but that when it falls at right angles with the refracting medium it suffers no refraction. The central ray in both A and B passes straight through without refraction; in A the inclination of the surfaces is such that the rays passing above and below the centre line converge at a point called the focus. The lens, B, being thickest at the margin, the effect is just the reverse; the rays are dispersed, and do not come to a focus but diverge, as if they proceeded from a point on the opposite side of the lens, called the virtual focus. These concave lenses do not magnify, but are used in microscopes and other optical instruments, for purposes to be hereafter mentioned: the most familiar instances to be cited of their use are as the eye-glass of an opera-glass or Galilean telescope, and as spectacles for short-sighted persons.

Lenses may be made with one side worked to a plane surface and the other either convex or concave, such lenses are known as plano-convex and plano-concave lenses; their respective powers are about half those of lenses of similar and double curvatures. There are also lenses convex on one surface, and concave on the other; these are called meniscus lenses; the curves may be so proportioned that they have either the power of convex or concave lenses, according as they are thickest in the middle or at the edge; they have, moreover, some properties peculiar to themselves which are turned to good account by skilful opticians.

The formation of images is one of the most valuable properties of convex lenses, and one taken advantage of in the construction of optical instruments. If a convex lens is held at the distance of its focal length in front of a sheet of paper or other white surface, an inverted picture more or less distinct will be seen of objects that may be before it, such as a window or candle flame. This is illustrated by the diagram Fig. 5, representing a candle flame on the left hand, from the apex of which two rays diverge, the lower

Fig. 5.



one reaching the lower edge of the lens and the upper one its centre. Rays proceed from each point of the flame to every part of the surface of the lens, but, for the sake of clearness, only two are here represented. After passing through the lens they converge; the same takes place with the rays proceeding from the lower part of the flame, which also pass through the lens. The result is the formation of an inverted image, the size of which and its distance from the lens are dependent upon the distance of the object and the focal length of the lens.

The greater the distance of the object, or "anterior focus," the shorter will be the distance of the image, or "posterior focus." The commonest example may be taken from the operations of the photographer, who, if he wants to take a small portrait, will place the sitter at a great distance from the camera, if, on the contrary, he desires a large figure, he will bring his model nearer; in the former case the posterior focus of the camera will be shorter than in the latter, which is shown by the camera requiring to be lengthened when the model is brought near to it.

Besides the use of lenses to form images, they are also employed as magnifiers, and constitute the simplest form of microscope. Most naturalists and microscopists are provided with some little contrivance of this kind either attached to the watch chain or carried in the pocket,—either one or more lenses suitably mounted, or the Stanhope lens. In all these simple microscopes no image is formed, so that the principle upon which a magnified view is obtained is different. The idea of the magnitude of an object is formed entirely by the space which it occupies upon the retina of the eye. It is quite irrespective of its actual size; or, to express it in mathematical language, an object is large or small in proportion as it subtends a great or small angle with respect to the eye.

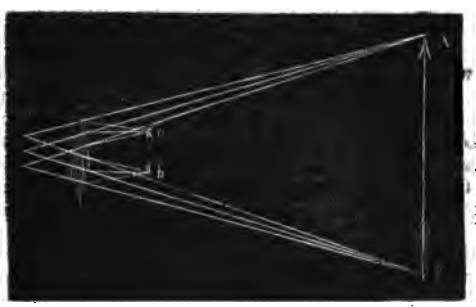
The eye has a certain power of adjusting itself to

view objects at different distances, but there is a limit to the distance of distinct vision. It varies from five to ten inches in different persons. An object cannot be distinctly seen nearer than either one or other of these distances, or some intermediate point. Now optical science supplies a means of overcoming this difficulty. An object apparently enlarged by being brought nearer to the eye, becomes indistinct, because the pencils of rays proceeding from it diverge too much to be brought to a focus on the retina by the lens of the eye.

The optical instrument most closely resembling the eye is the camera obscura. When the rack is run out to its full extent and the body is drawn out as far as it will go, and the object is still too near to be focussed distinctly, the position is precisely that of the eye with an object too close to it for distinct vision.

The remedy with the camera, supposing that no more focussing space could be obtained, would be to shorten the focus of the lens; that is, use one of greater refractive power. The same thing must be done in the case of indistinct vision, by interposing a convex lens and so increasing the convergent power of the lens of the eye; the object, hitherto too near the eye, *a*, *b*, is thus rendered visible and clearly defined, but with this remarkable difference, that it appears not to be the image of the object placed near the eye, but of a larger object, A, B, at the distance of distinct vision. No crossing of the rays takes place, and consequently the image is not inverted.

FIG. 6.*



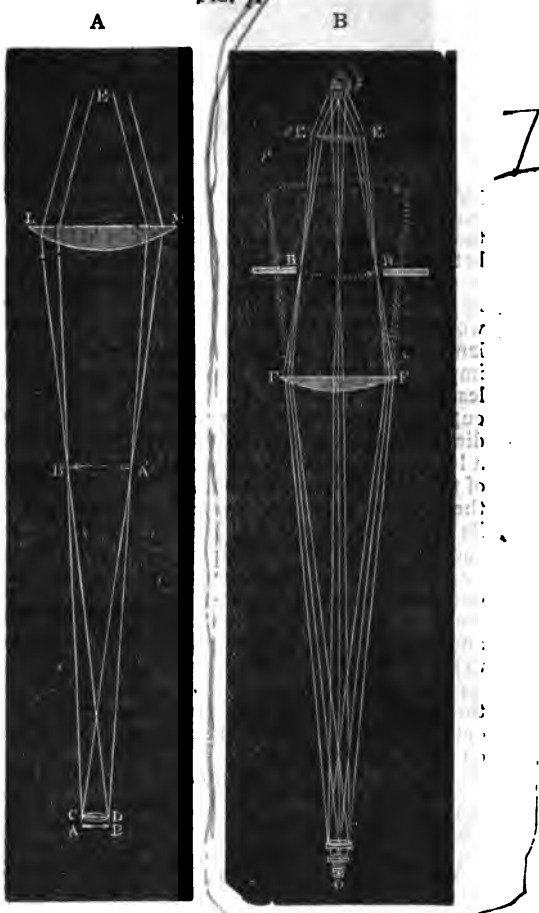
The hand magnifier is an extremely useful instrument, but many persons find great trouble in using it to advantage, especially when it is of short focus and high power. A trifling hint about its use may be of value.

Hold the object in the left hand, either in the fingers or with forceps, and, placing the left hand against the right which is holding the lens, look through the magnifier and adjust the focus. The view is usually most distinct when the eye is in one focus of the lens and the object in the other; the two hands being held in contact move together and prevent that tremor which would be apparent, especially with high powers, if the hands were kept apart, and which unsteadiness prevents any accurate view of the object being obtained. Single lenses, when their diameter exceeds that of the pupil, possess the property of bringing light to the eye and rendering the object clearer than it would be without such assistance. This may be proved by looking at print or other suitable object in a bad light and noticing how much the magnifier aids by its light-collecting power.

Single lenses are mounted on stands of various kinds, and then they become what are called single or simple microscopes. The older observers had no other instruments. These may consist of many lenses, while the compound microscope may be made with as few as two; but then they act upon the principle that no image is formed, but the object is rendered visible at a shorter distance than it could be without optical aid. Single microscopes are still in use for dissection and other purposes where only a low power is required. And various contrivances have been adopted by which both eyes may be used and much fatigue saved in protracted operations.

The compound microscope differs from the simple instrument just mentioned in an image being formed and again magnified by being viewed with another lens or eye-piece (Fig. 7).

FIG. 7.



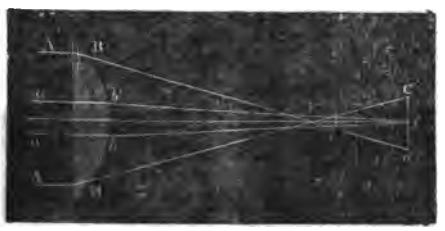
From what has been said before respecting the formation of images, it is evident if a lens of short focus is used and an object placed before it, the image will be formed at a great distance behind it and be much enlarged; if instead of viewing this image directly, as in the camera obscura, it is viewed with a suitable lens, another enlargement takes place. Such an instrument might be constructed with only two lenses, as in the diagram Fig. 7, A, but a microscope so made would of course be a very imperfect instrument; indeed it would in almost every point be inferior in its performance to that of a simple lens, principally because the eye lens magnifies all the

* Figs. 6, 7, 8, and 10 are taken from "The Microscope and its Revelations," by W. B. Carpenter, M.D. (Churchill).

imperfections of the image formed by the small lens or object-glass. These imperfections are chiefly caused by the spherical and chromatic aberrations of the object-glass, and also in some degree by those of the eye-piece.

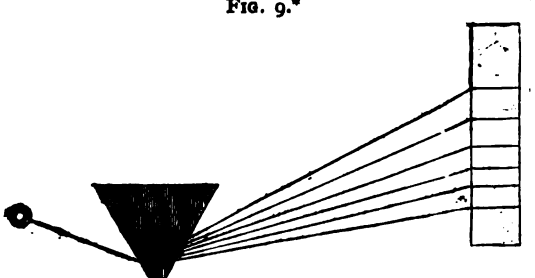
Theoretically, convex lenses bring parallel rays to a point called the focus, at a distance from the lens dependent upon the radii of their curved sides; practically, this is not the case; the rays passing through the marginal portion of the lens come to a focus at a shorter distance from it than those which pass through or near its centre (Fig. 8). Those

Fig. 8.



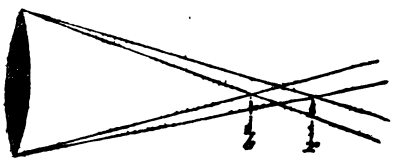
passing through intermediate portions converge to some part between these two points; the result is that indistinct images are formed at various points between F and *f*, Fig. 8, no well-defined figure being seen anywhere. Could lenses be made having an hyperbolic or elliptic section, the spherical aberration would be corrected, but the difficulties of making lenses of such figures are so great as to be considered impossible in practice. Spherical aberration may be lessened by reducing the aperture of the lens, by cutting off the marginal portion by means of stops or diaphragms; but any great use of this means causes a loss of light very detrimental to the performance of the instrument. Advantage may also be taken of the position in which the lens is placed and also of its figure; the spherical aberration of some lenses, such as plano-convex and meniscus, is much affected by the way they are placed, being much greater in one position than other. Much may be done by placing the glasses in their most favourable position and using suitable curves: as a striking example, take to pieces a photographic lens and observe the curious forms adopted in its construction. The details of these corrections are rather a matter for the practical optician, and are unsuitable for an elementary treatise on the microscope.

Fig. 9.*



Chromatic aberration is caused by the unequal refraction of the constituents of a ray of light. If a ray be bent by passing through a glass prism, instead of the ray appearing on the other side as white light it will be decomposed, owing to the unequal capability of bending which the rays possess; the red ray is bent least, the yellow more, and the blue and violet most of all (Fig 9). This also takes place when light is caused to pass through a lens (Fig. 10). The blue ray

Fig. 10.



being the most refrangible comes to a focus nearest to the lens at *b*; the red ray being the least refrangible will not converge until it reaches *r*; the yellow, green, &c., rays come to a focus at intermediate points, so that a series of images surrounded by fringes of their respective colours would be formed at various points between *b* and *r*, such coloured margins rendering the definition extremely defective. Chromatic aberration may be lessened by the use of stops, cutting off the marginal portion of the lens, but at the sacrifice of a great quantity of light and the impairing of some of the most valuable qualities of the glass for microscopic purposes. Fortunately, a means has been found of almost entirely correcting chromatic aberration. Different kinds of glass vary not only in their refractive power but also in the degree in which they disperse the coloured rays, and, by combining lenses of suitable forms and materials, the error of one lens is so neutralised by the opposite error of the other that the combination as a whole is nearly free from the production of colour, or becomes, as it is termed, achromatic. For the practical application of this valuable fact, we are indebted to the elder Dollond, who constructed telescopes on this principle towards the end of the last century. The object glass of the microscope was not improved until many years afterwards.

Owing to the very divergent condition of the rays proceeding from a minute object placed near the lens of a microscope, the construction of an achromatic object-glass is much more complex than the combination employed in other optical instruments. High powers contain as many as three combinations of compound lenses placed behind each other, the careful adaptation of which requires the greatest skill on the part of the optician, and necessarily causes objectives of large aperture and great perfection to be very costly. A valuable series of papers by Mr. F. H. Wenham on the construction of object-glasses for microscopes will be found in the *Monthly Microscopical Journal*, vol. I., pp. 111, &c.

So perfectly was the correction of the chromatic and spherical aberrations effected, that it was found that even the covering of the object to be viewed with a thin plate of glass or mica rendered the image sensibly indistinct: fortunately the defect was no sooner discovered than the late Andrew Ross applied a simple remedy; some alteration was made in the disposition of the correcting media, and the front combination allowed a small range of motion backwards and forwards, which is usually regulated by a graduated collar, the use of which it will be well to explain, as, although it is to be found in most works on the microscope, it seems to be generally overlooked. Makers differ a little in the details of their arrangement for this correction, but there will always be found some mark indicating when the object-glass is corrected, for viewing an uncovered object. Focus

* Hardwich's "Photographic Chemistry," p. 173 (Churchill).

carefully for distinct vision, with the glass so arranged, and then, taking hold of the collar, turn it round until a view is obtained of dust that may be resting on the upper surface of the cover of the slide; if the object is now focussed by the use of the fine adjustment, the correction for the thickness of the cover glass will be found to be very perfectly made, and as the collar is usually graduated, the number may be noted on the slide for future use, as it is constant with the same object and eye-piece, and also for the same thickness of cover-glass.

The eye-piece usually employed in the microscope in combination with achromatic object-glasses is that invented by Huyghens, a Dutch astronomer (Fig. 7, B), and consists of two plano-convex lenses (E E and F F), with their plane sides towards the eye; this eye-piece, although not achromatic, when used with object-glasses slightly "over-corrected," renders the instrument achromatic as a whole. The optical principles involved are far too complicated to find a place in the present paper.

The power of the instrument may be greatly varied by using a series of eye-pieces of different power, and if the corrections of the object-glass are perfect, and its angular aperture sufficient to admit a large amount of light, great advantage may be derived from the use of a short or "deep" eye-piece; but as the magnifying power of the eye-piece exaggerates every defect of the image, it is only with good object-glasses that this means of increasing the power is available. A very deep eye-piece is of value in testing the quality of an objective, as it causes defects which may not be apparent with lower powers to become very marked.

The power of the instrument is greatly influenced by the length of the tube or body, and were it not for the inconvenience of excessive length, this would probably be the least objectionable way of increasing the magnifying power, but a very long tube renders manipulation difficult, on account of its removing the hands to an uncomfortable distance from the stage and illuminating apparatus. Most microscopes have a sliding tube in the body known as the draw-tube, by which the length can be increased to the extent of four or six inches at pleasure.

(To be continued.)

PRELIMINARY NOTE ON A NEW CORNISH MINERAL.

By Professor CHURCH, M.A.

DURING a recent visit to Cornwall, I purchased from Mr. Talling, of Lostwithiel, some specimens of a dark brown, amorphous mineral which had been recently found by him. These prove to be an unrecognised silicate of iron. Here are, in brief, the characters of the new species:—

Hardness, 2·75; specific gravity, 1·74. Amorphous, reniform, fissured, dark brown. Streak, pale rust-brown. Fragile; fracture, irregular conchoidal. Blowpipe—in closed tube, much water, having slight permanent acid reaction; on charcoal, decrepitates, and becomes black; partially fuses in outer flame to a black bead, in inner to a red-brown. Boiled in acids, leaves a siliceous skeleton.

This mineral gives, on analysis, the following percentages:—

Water	10·51
Silica	36·39
Ferric oxide	52·94
	99·85

The mineral also contains 0·82 per cent of P_2O_5, and traces of magnesia. It loses 29 per cent of water *in vacuo*, and only 0·54 per cent more at 100°. The analyses were made with the substance dried at 100° C.

The numbers above agree with the expression—

$$5Fe_2O_3,9SiO_2,8H_2O,$$

which demands 53·74 per cent Fe_2O_3, 36·58 per cent SiO_2, and 9·68 per cent H_2O; but many considerations point to the simpler formula, $Fe_2O_3,2SiO_2,2H_2O$, which demands—

	Theory.	Experiment.
$2H_2O$	11·39	10·51
$2SiO_2$	37·98	36·39
Fe_2O_3	50·63	52·94
	100·00	99·85

The chief discrepancy between theory and experiment concerns the iron, which is greater than it should be. This arises from three causes—(1) Traces of the iron exists as a ferrous salt in the mineral; (2) the percentage of Fe_2O_3 includes 0·82 per cent of P_2O_5; (3) it is difficult to separate the haematitic matrix from every portion of the mineral taken for analysis. The causes which have raised the iron percentage have also been amongst those which have reduced the silica and water percentages below their theoretical amounts.

The new mineral, which I shall name on a future occasion, has been mistaken for beraunite: it accompanies pyrite, chalybite, quartz, black haematite, and cronstedtite.

Royal Agricultural College, Cirencester,
September 18th, 1869.

ON THE SUPPOSED ACTION OF LIGHT ON COMBUSTION.*

By CHARLES TOMLINSON, F.R.S., F.C.S.

THE popular idea that "light puts out the fire," is so fixed, that probably no conclusions drawn from actual experiment are likely to disturb it, especially if they be adverse to the notion. It is a matter of daily experience, people say, that, if the fire is nearly out, and you put a screen before it, or draw down the blind, or close the window-shutters, it will immediately begin to revive. It is generally forgotten that a fire that looks dull, or "out," in a well lighted room, will appear to be in tolerable condition in the same room when darkened. It only requires to be "put together" to make it burn up, and it might have been done so just as well in the light.

Experiments on this subject are not easy to make, on account of the many disturbing causes. In an old volume of the "Annals of Philosophy," is an account of some experiments by Dr. M'Keever, who took two portions of green wax taper, each weighing 10 grains, and ignited both at the same moment. One piece was placed in a dark room, at 67° F.; the other was exposed to broad sunshine, at 78° F.

In five minutes { The taper in sunshine lost .. 8½ grs.
" darkened room lost 2½ "

The taper, divided into inches, was also burnt in the coloured portions of the solar spectrum, when it was found that the time required to burn two inches of taper varied as follows:—

	Mins.	Secs.
In the red ray it took	8	0
In the green	8	20
In the violet	8	39
In the verge of the violet ..	8	57

The conclusion is, that the solar rays, in proportion to their intensity, have the power of retarding, to a con-

* Read before the British Association, Exeter Meeting, Section B.

siderable extent, the process of combustion; and it is supposed that the chemical rays act, in some way, on the portion of oxygen about to combine with the fuel, so as to delay, if not prevent, combination.

Supposing, in these experiments, the taper was so uniform, that one inch contained precisely the same quantity of matter as another inch, the time occupied in burning was too short to justify so important a conclusion as Dr. M'Keever arrived at, whether the results were taken by measure or by weight.

Everyone engaged in photometrical observations must be aware of the difficulty of getting rid of disturbing causes and perplexing results. In comparing candles of the same make, the light is affected, both in quantity and economy, by a number of small circumstances, such as the warmth of the room, the existence of slight currents of air, the extent to which the wick curls over in burning, and so on. In testing the quality of gas, the standard candle defined by Act of Parliament is a sperm candle of six to the pound, burning at the rate of 120 grains per hour. From such a standard, we get the terms "twelve candle gas," "fourteen candle gas," &c. Mr. Sugg, in his "Gas Manipulation," has pointed out some of the difficulties in obtaining a uniform standard candle. The wick does not always contain the same number of strands; they are not all twisted to the same degree of hardness; the so-called sperm may vary in composition—one candle containing a little more wax than another, or variable quantities of stearine or of paraffin; the candle may have been kept in store a long or a short time; the temperature of the store-room may have varied considerably, and the temperature of the room in which it was burnt may have been high or low. All these circumstances affect the rate of combustion, and the illuminating power of candles, irrespective of the action of light, if such action really exist.

I have lately had a good opportunity of testing this action at the works of Price's Patent Candle Company, at Battersea. Under the direction of Mr. Hatcher, the accomplished chemist of the Company, the greatest possible care is taken to ensure identity of composition and illuminating power in candles of the same name. There has lately been an extensive series of experiments on the photometrical value of sperm candles, during which, at my request, Mr. Hatcher was good enough to note the rate of combustion of such candles in a darkened room, and also in broad daylight, and even in sunshine.

In the first observation, three hard and three soft candles were burned, each for four hours, in a dark closet. A similar set of candles, taken from one and the same filling, were burned, during the same time, in open daylight, partly in sunlight. The average consumption per hour of each candle was as follows:—

Sperm, in the dark	.. .. ..	134 grs.
Ditto, in the light	.. .. ..	141 ,,
No. 2 composites	In the dark ..	133 grs.
	In the light ..	140 ,,

It must be noticed that the temperature in the light was 72°, and in the dark 71°; moreover, in the light there was a much greater motion of the air than in the dark closet. Both these circumstances would operate in producing a larger consumption of candle.

In a second trial with No. 2 composites, the results were:—

In the dark	..	140 grs. each candle.
In the light	..	134 ,, ,,

In a third trial, also with No. 2 composites, the results were:—

In the dark	.. ..	131 grs.
In the light	.. ..	129 ,,

In these two trials, the flames were protected, as far as possible, from currents of air; and, in a third trial, the temperature, both in the light and in the dark, was nearly equal.

The fourth trial was made on a bright, sunshiny day, with hard sperm candles, which are less affected by variations of temperature than the composites. The results were:—

In the dark (temperature, 81°), 544 grs., or 136 grs. per hour.

In the light (temperature, 84°), 567 grs., or 142 grs. per hour, nearly.

It is evident that, in this case, the increase of temperature caused by the bright sunshine led to an increased consumption of material.

It will be seen that, in the first and fourth trials, there is a greater consumption of material in the light than in the dark; and in the second and third trials, the consumption is greater in the dark than in the light; but, in any case, the difference is so small—amounting only to from 2 to 7 grains per hour—that it may fairly be referred to accidental circumstances, such as difference in temperature, in currents of air, and in the composition and make of the candles; the final conclusion to which I am led being that the direct light of the sun, or the diffused light of day, has no action on the rate of burning or in retarding the combustion of an ordinary candle.

SOME EXPERIMENTS WITH THE GREAT INDUCTION COIL AT THE ROYAL POLYTECHNIC.*

By JOHN HENRY PEPPER, F.C.S., Assoc. Inst. C.E.

The Large Induction Coil.

The length of the coil from end to end is 9 feet 10 inches, and the diameter 2 feet; the whole is cased in ebonite; it stands on two strong pillars covered with ebonite, the feet of the pillars being of a diameter of 22 inches. The ebonite tubes, &c. are the largest ever constructed by the Silver Town Works.

The total weight of the great coil is 15 cwts., that of the ebonite alone being 477 lbs.

The primary wire is made of copper of the highest conductivity, and weighs 145 lbs.; the diameter of this wire is 0·0925 of an inch, and the length 3770 yards. The number of revolutions of the primary wire round the core of soft iron is 6000, its arrangement being 3, 6, and 12 strands.

The total resistance of the primary is 2·201400 British Association units, and the resistances of the primary conductors are respectively—For three strands, 0·733800 B.A.U.; six, 0·366945 B.A.U.; twelve, 0·1834725 B.A.U.

The primary core consists of extremely soft straight iron wires 5 feet in length, and each wire is 0·0625 of an inch in diameter. The diameter of the combined wires is 4 inches, and the weight of the core is 123 lbs.

The secondary wire is 150 miles in length; it is covered with silk throughout, and the average diameter is 0·015 of an inch.

The total weight of this wire is 606 lbs., and the resistance 33,560 B.A. units. The length of the secondary coil is 50 inches, and the insulation throughout is calculated to be 95 per cent beyond that required. The secondary wire is insulated from the primary by means of an ebonite tube of ¼ an inch in thickness and 8 feet in length.

The length of the secondary coil is 54 inches, the diameter is 19 inches, and without the internal ebonite tube containing the primary wire and iron core it is a cylinder 19 inches in diameter and 6 inches thick.

The condenser, made in the usual manner with sheets of varnished paper and tinfoil, is arranged in six parts,

* Abstract of a paper communicated to the Royal Society, by J. P. Gassiot, F.R.S.

each containing 125 superficial feet, or 750 square feet of tinfoil in the whole.

A large and substantially made contact breaker, detached from the great coil and worked by an independent electro-magnet, was constructed and worked very well with a comparatively moderate power of 10 or 20 large Bunsen's cells; when, however, the battery was increased to 30 or 40 cells, it became unmanageable.

A Foucault break, with the platinum amalgam and alcohol above it, was now tried, and answered very much better than the ordinary contact breaker; there was no longer any burning or destruction of the contact points, although the great power of the instrument appeared to cause continued decomposition in the water of the alcohol placed above the platinum amalgam; and every now and then the spirit was violently ejected, probably by explosion of the mixed gases taking place in the amalgam, in which they collected in bubbles; the alcohol took fire constantly, and had to be extinguished. A large and very strong glass vessel (in fact, an inverted glass cell belonging to a bichromate battery) was bored through, and the neck fitted into a cap with cement, a thick wire covered with platinum being inserted in the botton; the platinum amalgam was poured on this, and over it a pint or more of alcohol; the contact wire was also very thick and pointed with a thick stud of platinum, and, being attached to a spring, contact was easily made and broken. Explosions did not occur, flashes of light could be seen between the amalgam and the alcohol, and the height of the column of the latter prevented the forcible ejection of the spirit, which no longer took fire. The break was used for eight hours in a continuous series of experiments.

The Bunsen's battery used in the experiments was made with the largest porous cells that could be obtained, and each cell contained about one pint of nitric acid.

Some experiments were tried with the battery arranged for intensity, and used with the complete condenser of 750 square feet of tinfoil and 1500 square feet of paper. At first five cells were used, and these gave a spark 12 inches in length. The number of cells were gradually increased until 50 were in operation, when a spark from 28 to 29 inches in length was obtained.

In order to ascertain whether any variation in the size of the condenser would affect the length of the spark, a number of experiments were tried; and it was found that when half the condenser was used the spark increased in length up to twenty cells, but not after.

Experiments were now tried to ascertain whether any increase in the length of the spark could be obtained by arranging the battery and the primary coil for *quantity*, but no material advantage was obtained by this arrangement; even where three groups of cells were connected a decrease in the length of the spark is observed when compared with the 45 or 50 cells arranged for intensity, the difference being as 20 to 28.

The spark obtained from the large coil is thick and flame-like in its appearance, and therefore it will be alluded to as the "flaming spark."

When the discharging point and circular plate are brought within 6 or 7 inches of each other, the flaming nature of the spark becomes still more apparent.

Two light yellow flames curving upwards appear to connect the opposite poles. If a blast of air from powerful bellows is directed against a flaming spark, the flaming portion can be blown away and increased in area, and thin wiry sparks are now seen darting through it, sometimes in one continuous stream, at another time divided into three or more sparks, all following the direction in which the flame is blown.

The flaming spark is very hot, and if passed through asbestos (supported on an insulating pillar), quickly causes the latter to become red-hot.

When powdered charcoal is shaken from a pepper-box into the flaming spark in a vertical line and in considerable quantities, the greater part of the light is obscured, and the whole form of the flaming spark presents the appearance of a black cloud with a line of brightly ignited particles fringing the bottom parts. If the charcoal is dusted through in small quantities, each particle becomes ignited, like blowing charcoal into a hydrogen flame.

When the flaming spark is directed on to a glass plate upon which a little solution of lithium chloride is placed, the latter colours the flame upwards to the height of 3 or 4 in the most beautiful manner; and if the point of the discharge is tipped with paper, or sponge moistened with a little solution of sodium chloride, the two colours (the yellow from the salt, and the crimson from the lithium) meet each other, a neutral point being found about halfway, and thus illustrating apparently the dual character of electricity, and that + passes to − electrical, and *vice versâ*.

The flaming spark can be obtained in perfectly dry air.

Whilst passing through common air, if blown against a sheet of damp litmus-paper, the latter is rapidly changed red. In order to ascertain whether the acid product was nitric acid, the flaming spark (9 or 10 inches in length) was passed through a tube connected by a cork and bent tube with a bottle containing distilled water, from which another tube passed to the air-pump; on drawing the air slowly over the spark, and passing the former into the bottle, nitric acid was obtained in large quantities, so much so that it could be detected by the smell and taste as well as by the ordinary tests. The popular notion that nitric acid is always produced during a thunder-storm would therefore appear to be correct. To determine the effect of a cooling surface on the flaming spark, a hole 1¼ inches in diameter was bored through a thick block of Wenham Lake ice, and the spark passed through the air in the tube of ice; no change took place, and the spark was still a flaming one.

When the spark was received on the ice, it lost its flaming character, and became thin and wiry, spreading out in all directions.

If the discharging wires were tipped with ice, the spark was always flaming when any thickness of air intervened between them. Even over the ice, if the spark passed a fraction of an inch above the surface, it was always a flaming one, but changed to the thin spark when the point of the discharging wire was thrust into the ice.

If one of the discharging wires of the great coil is brought to the centre of large swing looking-glass and the other wire connected with the amalgam at the back, the sparks are thin and wiry, arborescent, and very bright; the crackling noise of these discharges being quite different from that of the heavy thud or blow delivered by the flaming spark.

When the discharging wire is brought close to the flame of the looking-glass, or if a sufficient thickness of air intervenes, the spark again becomes flaming; or, as sometimes occurs, if the discharging wire is placed about 5 inches from the frame, the spark is partly flaming and partly wiry, *i. e.*, when it impinges on the glass.

The spectrum is a continuous one with the sodium-line.

When the blast of air is used, and the wiry sparks made apparent, then the nitrogen line appears.

The flaming spark has been ascribed by some experienced observers to the incandescence of the dust in the air, and especially sodium chloride.

To ascertain whether the "flaming spark" could be obtained with a small number of cells, the large Bunsen's battery was reduced to three cells, and it was found that no appreciable spark could be produced when the whole primary wire was used with less than five cells.

By reducing the length of the primary wire, and using the four divisions separately, with five cells the spark was wiry, and varied from 4½ inches to 6½ inches; with ten cells it was wiry, and varied from 8½ to 9½; in the latter the spark was slightly flaming. With fifteen cells the spark was slightly flaming, and varied from 10 inches to 11½ inches. With 20 cells a flaming spark varying from 11½ inches to 12½ inches was obtained.

When the two wires from the secondary coil are placed in water, no spark is perceptible, even when the wire was brought very close together, until they touch.

If the negative wire is passed through a cork, on which a glass tube (a lamp glass) is fixed containing a depth of 5 inches of water, and the positive wire is brought within half an inch of the surface of the water in the tube, it becomes red-hot, and if drawn further away from the surface the upper part of the tube is filled with a peculiar glow or light abounding in Stokes's rays.

The experiments with the vacuum tube, and especially Gassiot's cascade, are, as might be expected, very beautiful. When a coal-gas vacuum tube of considerable diameter, and conveying the full discharge from the secondary coil, is supported over a powerful electro-magnet axially, the discharge is condensed and heat is produced.

If placed equatorially, the heat increases greatly, and when the discharge is condensed and impinges upon the sides of the glass tube, it becomes too hot to touch, and if the experiment was continued too long the tube would crack.

The enormous quantity of electricity of high tension which the coil evolves, when connected with a battery of forty cells, is shown by the rapidity with which it will charge a Leyden battery.

Under favourable circumstances, three contacts with the mercurial break will charge 40 square feet of glass.

On one occasion a series of twelve large Leyden jars arranged in cascade were discharged; the noise was great: and each time the spark (which was very condensed and brilliant) struck the metallic disk, the latter emitted a ringing sound, as if it had received a sharp blow from a small hammer.

The discharges were made from a point to a metallic disk; and when the former was positive the dense spark measured from 18¼ to 18¾ inches, and fell to 8¼ inches when the metallic plate was positive and the point negative.

Variations of the Leyden-jar experiments were tried by connecting the coil worked by a quantity battery of 25+25 cells with six Leyden jars arranged in cascade, and the spark obtained measured 8¼ inches.

The same six jars connected with the coil, when the fifty cells were arranged continuously for intensity, gave a spark of 12 inches of very great density and brilliancy.

NOTICES OF BOOKS.

Arithmetical Exercises for Chemical Students. By C. J. Woodward, B.Sc., Lecturer on Chemistry and Physics, Midland Institute, Birmingham. Birmingham: The Educational Trading Company (Limited). London: Simpkin, Marshall, and Co.

We have received, under the above title, a series of ten very neatly printed cards, enclosed in a case. Instead of "Exercises for Chemical Students," it would have been better to write Students of Chemistry.

The author very properly and truly states that, in almost all examination papers on the subject of chemistry, there are introduced questions involving considerable arithmetical calculation. Each card of this series contains all the data necessary for working the problems, and certain questions, which may be looked upon as *type* questions, are worked out in full. The subjects include—(1) the metric system of weights and measures; (2) conversion of thermometer scales—correction of gases for pressure and temperature; (3) specific gravity; (4) formula of a body being given, required either its percentage composition, or the quantity of any constituent a given weight of it will contain; (5) percentage composition of a compound being given, required its empirical formula; (6) quantity of material to yield, liberate, or produce a given weight of a substance; (7) required the bulk of a substance produced in certain decompositions, or, conversely, the volume of a substance necessary to effect certain decompositions; (8) combinations and decompositions of bodies in the gaseous form; (9) the crith and its uses; thermal units (by "crith" is understood the weight of 1 litre of hydrogen at 0° C., and 760 m.m. Barometer); (10) specific, atomic, and latent heat.

Very opportunely, these cards have been published at the moment that the courses of lectures are commenced at the various schools in the kingdom. A careful perusal justifies us, we think, in recommending these cards to all students of chemistry and physics; and a number of teachers will also find them a very useful addition to their library-table. As far as perusal goes, we have no fault to find with this work; and its very moderate price, especially considering the large amount of highly useful information contained in ten duodecimo cards, holds out a good inducement for students who really desire to obtain, within a very small compass, a permanently-useful pocket companion to purchase this work.

MISCELLANEOUS.

Death of the Master of the Mint.—With sincere regret, we learn that Professor Thomas Graham, F.R.S., Master of the Mint, died on Thursday night, the 16th inst., at his residence in Gordon Square. Mr. Graham succeeded Sir John Herschel at the Mint in April, 1855, and was, at the time of his decease, in his sixty-fourth year. He was born at Glasgow, on the 20th of December, 1805. He was the son of a Glasgow merchant, and was educated at the Grammar School and the University of that city, and afterwards spent some years in Edinburgh. He returned to Glasgow, where he distinguished himself as a practical chemist, and was elected Professor in the Andersonian Institution. In 1837, he was appointed Professor of Chemistry in University College, London, and, in 1855, he was appointed Master of the Mint. To the duties of this office he applied all his varied scientific knowledge, and, at the same time, devoted himself to original investigations in his favourite science. To him we are indebted for the discovery of the laws of the diffusion of gases, the diffusion of liquids, and the new method of separation known as dialysis. More recently, his analysis of an aërolite, which he found to be partly composed of hydrogen, afforded an interesting confirmation of the results obtained by spectrum analysis as to the constitution of heavenly bodies. His "Elements of Chemistry" is a standard work, and has had a large circulation both in England and Germany, the German translation being edited by Professor Otto, of Brunswick. In 1836, Mr. Graham became a Fellow of the Royal Society. In 1848, he was elected a Corresponding Member of the Academy of Sciences of the Institute of France; and, in 1855, the University of Oxford conferred upon him the honorary degree of D.C.L. The loss of the deceased *savant*, who was a bachelor, will be very seriously felt in the scientific world and also at the establishment of which he was the head, where he has rendered eminent service to the nation at large by the introduction of many great improvements.

The Whitworth Scholarships.—The following candidates have been reported to the Science and Art Department as entitled to the ten Whitworth scholarships of £100 a-year each:—William H. Greenwood, aged 23, engineer, student at the Mechanics' Institution, Manchester, 143 marks; Thomas A. Hearson, aged 23, engineer, student, Royal School of Naval Architecture, 137 marks; John Hopkinson, B.Sc., aged 19, student at Cambridge University, 134 marks; Thomas S. Elgood, aged 24, mechanical engineer, Leicester, and Owen's College, Manchester, 127 marks; George A. Greenhill,

aged 21, student at Christ's Hospital School and Cambridge University, 116 marks; John R. Brittle, aged 23, engineer, student at Sir Walter St. John's School, Battersea, 113 marks; Thomas W. Phillips, aged 23, student at British School, Millwall, and Royal College of Science, Dublin, 100 marks; Richard Sennett, aged 21, engineer, student at the Royal School of Naval Architecture, 98 marks; Robert B. Buckley, aged 21, engineer, student at Merchant Taylors' School, 97 marks; Charles E. Leeds, aged 23, B.A. (Oxon.), student at Oxford University, 96 marks.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, August 30, 1869.

This number contains the following original papers bearing upon, or more or less relating to, chemistry and allied sciences:—

Antidote of Nicotine.—M. Armand.—The author proposes that the deleterious effects of the use of tobacco should be counteracted, if not entirely annihilated, by moistening tobacco, while undergoing the various preparations and fermentations, previous to its delivery to the consumer, with a strong infusion, or other preparation, of watercresses, since the author has discovered that this vegetable contains principles which, without destroying the peculiar aroma of tobacco, destroy the deleterious effects of nicotine.

Action of Hydrate of Potassa upon the Sulphuretted Derivatives of the Carbides of Hydrogen.—M. Berthelot.—The author has studied the action of fusing caustic potassa upon the sulphuretted derivatives of some hydrocarbons which are not decomposed by water or alkalies at 100°. The soda-salt of hydrethylosulphuric acid, $C_4H_9S_2O_6$, is readily decomposed, and the result is the formation of pure ethylen and an alkaline sulphite—

$$C_4H_9NaS_2O_6+KHO_2=C_4H_4+H_2O_2+S_2KNaO_6.$$

Formenosulphate of soda, $C_2H_3NaS_2O_6$, should, by analogy, have yielded methylen, C_2H_2; but an excess of potassa decomposes the formenosulphate of soda, yielding hydrogen and carbonate and sulphite of alkalies—

$$C_2H_3NaS_2O_6+3KHO_2=C_2K_2O_6+S_2KNaO_6+3H.$$

With a relatively small quantity of potassa, a very volatile methylsulphide is formed, which, in many respects, is like methylic mercaptan. The author has extended his researches over a large number of equally complex compounds as those already alluded to; but, to be well understood, it would be required to quote a very large number of complicated formulæ; we therefore refrain from further abstraction of this paper.

Synthesis of Acetic Acid from Acetylen by a New Method.—M. Berthelot.—After referring to a now well-known method for the conversion of acetylen into acetic acid, devised by this author some time ago, the author now communicates another, and easier method—to wit, the heating of protochloride of acetylen, either with aqueous potassa solution up to 230°, or heating with an alcoholic solution of potassa up to 100°, for about ten hours. When the perchloride of acetylen is heated with an alcoholic solution of potassa up to 100°, glycolic acid is formed; and when the same perchloride is heated with aqueous potassa up to 230°, oxalic acid is formed.

September 6, 1869.

This number opens with a report on the practice of—

Heating Wines in order to Improve and make the same Keep Better.—M. Pasteur.—The contents of this paper are only interesting to wine growers. It appears, however, that the cautious heating of wine (on the large scale, and before it has reached maturity) not only improves its quality, but has the effect of making it keep better, and render fit for transport on long journeys, and by sea, such brands of French wines as are otherwise not suitable, on account of their rapid deterioration.

Detailed Account of the Spectrum of the Sun's Spots.—Rev. Father A. Secchi, S.J.—This indefatigable *savant* gives in this paper a very precise and fully detailed description of this difficult subject, which, however, since it is treated in a strictly astronomical style, we do not further allude to.

Nature of Aniline Green.—MM. A. W. Hofmann and Ch. Girard.—The authors treat, in this memoir, the following subjects:—*What is iodine green?* is a question first answered by stating that it is a secondary product, which is formed during the manufacture of the colouring matters generated by the methylation and ethylation of rosaniline, and known in commerce as Hofmann's violets. The preparation of iodine green (more correctly, green produced by iodine) is next treated at length; the preparation of this substance in crystallised state is then fully described. The composition of this green is—

$$C_{52}H_{52}N_6OI_2=\left\{\begin{matrix}H_{18}\\C_{20}(CH_3)_2\end{matrix}\right\}N_2\left\{\begin{matrix}CH_2I\\CH_2I\end{matrix}\right\}H_2O.$$

This memoir is a very lengthy and exhaustive monograph on this subject not well suited for further condensation.

Thermochemical Researches on the Substances formed by Double Decomposition.—MM. Berthelot and Longuinine.—This memoir, divided into several chapters, is too much filled with a very large number of figures, without which this paper cannot be well understood, and, therefore, we regret that we can only here quote the title of a highly scientific memoir wherein the authors have laid down the results of a long series of carefully-made experiments.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 200, August, 1869.

Leaving the papers relating to mechanics, steam engineering, and watchmaking, met with in this number, we notice the conclusion of a very lengthy, yet very excellent, monograph on—

Truffles.—M. Chatin.—The chemical composition of these cryptogamic vegetables has been investigated at even so early a period of the infancy of chemical analysis as the year 1803, and at various epochs after that year, such investigations have been especially conducted in France. The latest researches on this subject have been recently made, and are quoted by the author, as well as the analysis made by M. Payen. From these we learn that the *Agaricus campestris*, the edible mushroom, contains, in 100 parts:—Water, 91·010; nitrogenous matter and traces of sulphur, 4·680; fatty matter, 0·396; cellulose, dextrin, sugar, and mannite, 3·456; saline matter, 0·458, among which there is a very large proportion of phosphoric acid. Genuine truffles contain 76·60 per cent of water and 23·40 per cent of solid matter, including 7·16 per cent of nitrogen; upon 100 parts, the ash of truffles contains 27·40 phosphoric acid, and 28·34 potassa; the quantity of phosphoric acid contained in the ash of truffles growing in the neighbourhood of Nérac amounts to 33·5 per cent. This paper contains valuable information on the cultivation of truffles, on the bibliography of this subject, and on the commercial importance of a vegetable which, at first sight, one would hardly credit to yield, to fifty departments of France, a sum of nearly 16,000,000 francs yearly. The author states that these vegetables are highly nutritious, and that, when taken at meals in lieu of butcher's meat, they are readily enough digested, provided they are properly cooked, for which purpose the author gives the necessary directions.

Estimation of the Quantity of Non-Saponified Fatty Matter contained in Soap.—Dr. Bolley.—Dry the soap at 100°, in order to eliminate, as much as possible, any water it contains. Treat the soap, after having been previously reduced to thin shavings, or powder, if possible, with rectified benzol, or petroleum naphtha. Boil the soap for several hours with this fluid placed in a retort, and take care to pour back into that vessel any of the hydrocarbon which distils over. Next filter the liquid, and evaporate on a water-bath. 11·3 grms. of Marseilles soap (this is made with inferior kinds of olive oil and soda) treated in this manner left a residue, on evaporation, weighing 0·145 grm., or 1·2 per cent; this quantity consisted of the non-saponified fatty matter, and a very small quantity of soap which had been dissolved. On igniting the residue just mentioned, it left 0·002 grm. of ash, equal to 0·13 per cent of the soap submitted to analysis.

Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux, Arts de Belgique, No. 6, 1869.

This number contains the following original papers relating to chemistry:—

Researches concerning the Isomerism of the Salicylic Series.—M. Henry.—The chief object of this lengthy memoir is the study of the action of pentabromide of phosphorus upon a number of salicylic compounds. Considering the existing analogy between pentachloride and pentabromide of phosphorus, the conclusion seemed justifiable that these two bodies would act in the same manner upon aldehyde and salicylic acid. The author's researches have proved that, instead of this supposition being correct, the pentabromide behaves as if it were free bromine, giving rise to the generation of bromated organic compounds only.

Researches concerning the Ethereal Derivatives of the Acids and Polyatomic Alcohols.—M. Henry.—The author gives a review of his experiments on the chloride of ethylglycollyl, obtained by the action of terchloride of phosphorus upon ethylglycollic acid. The author's aim was to apply that chloride, in order to produce several diglycollic combinations which would have been interesting for the elucidation of isomerism in general; this aim has not, however, been attained by the author at present.

Researches on the Derivatives of Phenyl-Acetic (α Toluic) Acid.—Dr. Radziszewski.—This memoir, like the two foregoing, of which the headings were mentioned, does not admit of suitable abstraction. This second portion of a monograph on this subject is divided into nine separate sections, and contains a complete and exhaustive review of a lengthy series of complex compounds derived from phenyl-acetic acid, $C_6H_5—CH_2—CO(OH)$.

The American Journal of Science and Arts, July, 1869.

This number contains the following original papers:—

Charles Grafton Page.—A biography of this deceased philosopher, who has been, for a series of years, one of the foremost scientific investigators of the Union.

Hortonolite, a New Member of the Chrysolite Group.—Messrs. Brush and Blake.—The mineral alluded to has a dark yellowish green colour on the fresh fracture, and a vitreous to resinous lustre; hardness, 6·5; sp. gr., 3·91. Before the blowpipe in the closed tube no change takes place; in the open tube, and on charcoal, the mineral becomes dull and magnetic, and fuses in the platinum forceps; with borax and salt of phosphorus it yields the reaction for iron and silicic acid, and with soda for manganese. The pulverised mineral forms, with hydrochloric acid, a gelatinous mass, and is almost completely decomposed. Average composition, in 100 parts:—Silica, 33·59; protoxide of iron, 44·37; protoxide of manganese, 4·35; magnesia, 16·68; lime, a trace; potash, 0·39; loss on ignition, 0·29. A spectroscopic examination of the concentrated chlorhydric solution showed sodium, potassium, and calcium lines only.

Effect of Atmospheric Air, when Mixed with Gas, in Reducing its Illuminating Power.—Messrs. B. Silliman and A. Wurtz.—The results arrived at by the authors may be summarised as follows:—For any quantity of air less than 5 per cent, mixed with gas, the loss in candle power due to the addition of each 1 per cent is a little over 6-10ths of a candle (0·611 exactly); above that quantity, the ratio of loss falls to half-candle power for each additional 1 per cent up to about 12 per cent of air; above which, up to 25 per cent, the loss in illuminating power is nearly 4-10ths of a candle for each 1 per cent of air added to the gas. With less than one-fourth of atmospheric air, not quite 15 per cent of the total illuminating power remains, and with between 30 and 40 per cent it totally disappears.

Formation of Sugar in the Liver.—Dr. Barker.—A physiologico-chemical essay.

Aurora at Toronto, Canada.—Mr. Kingston.

Qualitative Separation of Cobalt and Nickel.—Mr. F. W. Clarke.—As is well known, ferricyanide of potassium precipitates cobalt and nickel from their solutions. The cobalt precipitate is of a deep reddish brown colour, while the nickel compound is of a dirty yellowish brown. The nickel ferricyanide is readily soluble in ammonia and in solution of cyanide of potassium, while the corresponding cobalt compound is absolutely insoluble in either. It is a noteworthy fact that the previous presence of either ammonia or potassium-cyanide entirely prevents the precipitation of cobalt by the ferricyanide; the solution, when ammonia is present, merely assuming an intense blood-red colour. It is always best to employ ammonia to dissolve the nickel precipitate, since the presence of a cyanide renders the subsequent detection of that metal rather difficult. The author proceeds, as follows, in an analysis:—To the slightly acid solution containing the two metals, first an excess of chloride of ammonium is added; this causes the cobalt precipitate, which otherwise would run through the filter, to fall in a denser state, and also of much darker colour, often nearly black. The ferricyanide of potassium is then added, until the precipitation is complete, and afterwards strongly agitate with a considerable excess of ammonia. Upon filtering, all the cobalt remains upon the filter, being recognised by the characteristic colour of the precipitate, and the nickel is readily detected in the filtrate by means of ammonium-sulphide. This process is merely offered, the author states, as a convenient means of detecting cobalt and nickel in presence of each other in ordinary analyses.

Wollongongite, a remarkable Hydrocarbon found in the Wollongong District of the Illawarra Coal Field, N. S. Wales.—Mr. Silliman.—This remarkable substance occurs five miles inland, and forty miles south of Sydney, in cubical blocks, without lamination, extremely tough, and resounding like hard wood under the blows of the hammer. Hardness, 2·5; sp. gr., 1·04 to 1·49; lustre, resinous; colour, greenish black and brownish black; tasteless; insoluble in alcohol, ether, or benzol; slightly soluble in sulphide of carbon; heated in a test-tube, it does not melt, decrepitates and distils a copious flow of oil of a yellow colour and heavy odour, giving off much gas; it is readily kindled, in thin splints, by a match, burning with a brilliant flame and much smoke. Analysis in platinum crucible yields:—Volatile matter, 82·5 per cent; fixed carbon, 6·5 per cent; ash, 11·00 per cent.

Estimation of Carbonic Acid.—Mr. S. W. Johnson.—Since the woodcut added to this paper is absolutely required for it to be clearly understood, we do not abstract it here.

Journal für Gasbeleuchtung, July, 1869.

We notice from this number the following papers and communications of more general interest:—

Effect of Illuminating Gas upon Vegetation.—Dr. Poselger.—The author of this paper deserves the thanks of a great public for his energy in determining, by positive experiments, that the death of fine trees growing along the streets and promenades of many, especially continental, towns, is not due, as has been too often asserted, to the effects of leakage in gas mains. From the author's experiments, made with trees and shrubs, it is a settled point that no damage can accrue to the trees, nor their growth interfered with, by any quantity of gas which may escape in the soil and find its way to their roots. Moreover, the author points out that no care is taken at all with the trees, as regards keeping the soil covering the roots, so as to admit of air permeating freely; that too often that soil becomes as hard as rock; and that, in very many cases, the filthy habit of using trees, especially if so thick as to admit of a man hiding behind it, instead of urinals, contributes largely to the destruction of fine old trees. The leakage of gas, or the laying down of mains near the roots, has nothing to do with this destruction; other causes influence the decay of trees, but with these we do not further occupy ourselves.

Brief Abstracts from the Reports of the Meeting of German Gas Engineers and Gas-Works' Managers held at Coburg at the end of May.—*Analysis of Oberursefer Oxide of Iron.*—This material is applied for the purification of gas, and was found to consist principally of 36·5 per cent of a siliceous sand, 38 per cent of Fe_2O_3, and 11·7 per cent of Mn_3O_4. The material known as Mannheim oxide of iron contains 98 per cent of Fe_2O_3, and small quantities of lime and sand. *Report of the Committee on Photometry.*—This paper contains a description of a series of experiments made at Frankfort-on-the-Maine, with the view to enable the gas-works' managers throughout Germany and some adjoinining countries to adopt a general plan of making photometrical tests of the gas they manufacture. From this report, we learn that the use of glycerine, instead of water, in wet gas-meters is attended with some danger, owing to the fact that, after a length of time, the glycerine appears to attack the metal working parts of the meter, and give rise to leakage. The quantity of gas consumed last year in Paris amounts to 138,797,911 cubic metres; this figure has to be multiplied by 35·3165 to convert it into English cubic feet.

Les Mondes, August 19, 1869.

This number contains:—

The Electrical Machine of Holtz.—Dr. P. J. Kaiser, the celebrated astronomer and physicist, of Leyden University, and his equally eminent colleague, Professor Ryke, have been not only experimenting with this instrument, but have very much improved its construction, and thereby largely increased its efficacy. We regret that we cannot enter into details on this subject, owing to the fact that, for the proper understanding the woodcut annexed to the original would have to be reproduced.

Theoretical and Practical Studies on the Divers Processes in Use for the Purification (Defecation) of Beet-Root Saccharine Juice by means of Lime and Carbonic Acid.—M. Feltz.—This paper treats, at length, on a subject of considerable importance to the parties more immediately interested, beet-root sugar manufacturers. There is added to it a very precise description of the different methods of estimating the quantity of lime contained in the clarified juice, and, also, divers processes for the quantitative estimation of the organic matters, other than sugar, contained in the said juice. The paper is too long, however, for useful abstraction, and is to be continued in following numbers of this periodical.

We learn from this number that two scientific men of great name in their time have died at an advanced period of life—Prof. Purkinge, of Prague, died on the 24th of July last, aged eighty-two years; Dr. Carus, of Dresden, born in 1789, died also a few weeks ago.

August 26, 1869.

This number contains the following original article:—

Theoretical Chemistry.—M. Maumené.—The author's chief object is to prove that chemists should avail themselves of the author's "Théorie Générale de l'Action Chimique"; and, in order to exhibit it, the author refers to M. Schutzenberger's recent discovery of hydrosulphurous acid. Hydrosulphite of soda, $NaO.S_2O_3H$, when exposed to heat, after having been carefully dried, yields a little water, sulphur, and sulphurous acid, and leaves a residue consisting of sulphate and sulphuret of sodium. The author of this paper puts the question, Why hydrosulphite of soda should give, under the influence of heat, all the products just enumerated? Why should we not have a more simple action? as, for instance—

$$NaO.S_2O_2H = NaO.SO_3 + HS,$$

or—

$$= NaO.SO_3 + HO + S.$$

Every impartial chemist will at once admit that not one of the hypotheses at present current in the science of chemistry can serve to explain this. My theory exhibits precisely why these more simple actions cannot take place, and why all the bodies observed to be formed by M. Schutzenberger, must of necessity be formed. When a salt is submitted to the action of heat, the acid and base of that salt only constitute, during the action of the heat, a simple mixture acting by equal weight. For one equivalent, E, of one of these two bodies (that is to say, that which has the highest equivalent), the number, n, of the equivalents, E', of the other body (that the equivalent of which is the lowest) is expressed by the general formula—

$$n = \frac{E}{E'}$$

We have, therefore, in the present instance—

$$n = \frac{57(S_2O_2H)}{31(NaO)} = 1·84$$

that is to say, that the equivalent of the acid S_2O_2H, at the moment that the heat becomes strong enough to cause its dissociation from the soda, acts upon 1·84, say, nearly two equivalents of soda. We have, therefore—

$$2NaO + S_2O_2H = NaO.SO_3 + NaS + HO.$$

This first action is followed by a second; one-half of the acid was free; it has, by itself, been exposed to the action of the heat, and gave—

$$S_2O_2H = SO_2 + S + HO.$$

The total result of the decomposition is, therefore, the sum of the equals—

$$2NaO.S_2O_2H = NaO.SO_3 + NaS + SO_2 + S + 2HO,$$

as observed by M. Schutzenberger.

Cosmos, August 21, 1869.

This periodical contains, among other interesting matter :—

Description of the Self-Registering Instruments used at the Kew Meteorological Observatory.—Messrs. R. and J. Beck.—The editor of this paper states that, since these well-known eminent instrument makers are amongst his subscribers, he has been favoured with the excellent woodcuts and description given by the makers of the instruments.

Discovery of Coal.—On the eastern shores of the Caspian sea, abundant seams of coal have been found. The steam-ships navigating on that sea have hitherto used wood as fuel, which had to be carried far away from the Ural mountains, at great cost. The coal is of very good quality. More than forty years ago, the late A. von Humboldt stated his belief that coal would be found in this region at no great depth under the surface of the ground, since this entire locality abounds in naphtha.

Pharmaceutische Zeitschrift für Russland, May, June, and July, 1869.

These three numbers of this periodical have been published simultaneously, and are, therefore, taken together. The leading article, commenced in the May number, and continued through the two others, is a lengthy monograph on the following subject :—

Best Method of Preparation and Constitution of Hyoscyamine, and the relation this Alkaloid bears to the Quantity of Nitre (Nitrate of Potassa) contained in the Plant wherein the Alkaloid occurs.—M. Thorey.—The author divides this paper into three sections, respectively headed—On the preparation of hyoscyamine; the constitution of that substance; and its relation to the quantity of nitre the plant which yields it contains. The preparation of this alkaloid is described by the author with full details, as given by the very large number of chemists and pharmaceutists who have worked on this subject. Among the various methods of preparation of this alkaloid devised by the author, we notice the following :—50 grms. of *Semina hyoscyami nigri* (common henbane) are ground to powder, exhausted with 150 grms. of alcohol (85 per cent strength), and the alcoholic tincture concentrated by distillation, one-half of the bulk of the alcohol being distilled off. The residue left in the retort is next mixed with water, filtered, reduced, by evaporation, to about 30 grms., and then again filtered. The filtrate is mixed with a solution of caustic potassa, after having been previously heated to 40°, next treated with chloroform, the chloroformic solution washed with water, until that fluid runs off quite clear, and the solution thus obtained evaporated to dryness, leaving 0·0835 grm. of a yellowish mass smelling like tobacco. This mass is re-dissolved in weak hydrochloric acid, filtered, carefully saturated with caustic potassa, again treated with chloroform, this solution again washed with water, and, at last, left to spontaneous evaporation over sulphuric acid, yields well-crystallised hyoscyamine. The alkaloid thus obtained is a quite pure, colourless substance, of bitter taste, readily soluble in dilute alcohol, in ether and chloroform, in benzine and amylic alcohol, and dilute acids. Among its characteristic chemical reactions, belongs a red amorphous precipitate, with the double iodide of bismuth and potassium; a yellow precipitate, gradually verging on blue, when left standing with phospho-molybdate of soda; a flocculent yellow precipitate with chloride of gold, which, after a time, becomes crystalline; a deep kermes red colouration with aqueous solution of iodine; and an amorphous yellowish grey precipitate with tannic acid. During his researches on this subject, the author has discovered that henbane contains, in addition to hyoscyamine and saltpetre, a peculiar resinous substance, and an acid. The resinous material is remarkable, since it contains nitrogen, its percentical composition being—C, 67·67; H, 8·772; N, 3·508; O, 20·05. As regards the constitution of hyoscyamine, the author says it is, at present, not easily possible to control the statement made by M. Kletzinsky, that this alkaloid should be the nitrile of santonate of ammonia. The question, What relation the hyoscyamine bears to the quantity of saltpetre contained in the plant which yields it? is treated at great length; but it is difficult to give any brief *résumé* of these researches, which are recorded in several tabulated forms full of figures. All parts of the henbane contain a considerable quantity of nitrate of potassa; and it appears that, while that quantity varies at various periods of the growth of the plant, so, also, varies the quantity of hyoscyamine contained in the various parts of the plant. The quantity of hyoscyamine contained in the leaves of the plant dried at 110°, and taken before the blooming period, varies from 0·023 to 0·208 per cent. The seeds contain from 0·048 to 0·160 per cent of hyoscyamine.

The Saline Deposits of Turkestan.—M. Palm.—The author says that he was sent on a long journey through a very little frequented portion of the Asiatic part of the Russian empire, and that, during that time, he studied especially those saline deposits which are not chiefly composed of common salt, known by the German name of *salz-steppen*. The first deposit alluded to in this paper is met with near Fort Perowski, and consists of alternate layers of a saline mass and fine white sand, impregnated with a salt soluble in water. As instances of the composition of this salt, we quote the following analysis from this paper:—Percentical composition—NaO, 42·4; SO_3, 54·8; water, 2·0; sand, 1·0. Sulphate of soda, 47·215; common salt, 2·719; water, 48·50; sand, 1·566; formula—

$$NaO,SO_3 + 8\,aq. + 1\text{-}14th\ eq.\ NaCl.$$

Sulphate of soda, 57·26; common salt, 10·18; water, 35·56; formula—

$$10(NaO,SO_3) + 2(NaCl) + 9HO.$$

The author describes, very minutely, these deposits, and a number of others, stating that several millions of tons of sulphate of soda are deposited in this far away region, inhabited only by a few Nomadic tribes, and by the Cossacks, who do duty along the great roads as a military police.

Very Black and Very Cheap Ink.—M. R. Voigt.—Take 12 ozs. of extract of logwood, 1½ lbs. of best nutgalls, 1 lb. 6 ozs. of dried sulphate of iron (*sulphas ferri ustum*), 1 lb. 1½ ozs. of senegal gum, 1 oz. of commercial sulphate of copper, ½ a drachm of corrosive sublimate, and 45 lbs. of water. The nutgalls, previously ground to a coarse powder, are macerated for four days with 12 lbs. of previously well boiled, and afterwards quite cooled, water, taking care to place the mixture in a cool place. The extract of logwood is also dissolved by itself in 12 lbs. of the same water; the previously dried sulphate of iron is dissolved by itself in 5 lbs. of that water; the sulphate of copper is, also, separately dissolved in ½ a lb. of water. The quantity of corrosive sublimate is, likewise, separately dissolved in 4 lbs. of the said water, while the gum is dissolved in 9 lbs. of that same fluid. Each of these solutions should be filtered, either through a very fine hair sieve, or through linen; and, after that, the solutions should be mixed together in the same order as they are here enumerated. The ink thus obtained should be bottled, and the bottles, after having been well corked, kept in a cool place. 1 lb. of this ink can, according to this author, be had for the low price of 6 kopéiks (about three farthings).

Comparative Study on the Characteristics of the Halogens and their Combinations, and especially, also, on Hyperiodic Acid.—Dr. Ferrein.—This monograph contains the history of the halogens (chlorine, bromine, iodine, fluorine), treated at length, from the earliest days of Lavoisier and Scheele up to the present time. The essay is too lengthy for any useful abstraction.

On Mercurialin.—M. Reichardt.—The preparation of this substance from the *Mercurialis annua* is given at great length; it is a complicated process, requiring great nicety of manipulation. Mercurialin is an oily fluid, at first colourless, but readily becoming brownish tinged by the action of heat, as well as by simple contact with air; it is an alkaloid, exhibiting a strongly alkaline reaction to test paper. The formula of mercurialin, as deduced from its salts, is C_8H_9N. The author has studied a series of the salts of this substance, most of which salts crystallise, and some are capable of forming well-defined double salts.

Steam-Boiler Incrustations.—M. E. Wiederhold.—The author states that the hardest incrustations of this kind are formed when the quantity of carbonate of lime amounts to from 20 to 25 per cent of the entire mass. He has found, by an experience extending over several years, that some kinds of clay, among these, the substance known as *kieselschiefer* (a peculiarly fatty clay), when suspended in the water contained in steam-boilers, prevent the particles of carbonate and sulphate of lime dissolved in the water, even if the latter is very hard, to cling together, and become fixed to the sides of the boilers, forming there a hard incrustration. A series of experiments, made on purpose, and continued for a sufficient length of time to yield a reliable result, has fully proved that the addition to the feed-water of the steam-boilers of fatty clays, especially the kind known as fuller's earth, entirely prevents boiler incrustations, even where, of necessity, very hard water has to be used as feed water. A loose, soft mud is deposited as soon as the motion of the water, due to the boiling, ceases on cooling. This mud readily runs off on opening the sludge-valve of the boiler.

Zeitschrift für Chemie, von Beilstein, No. 14, 1869.

This number contains only two original papers :—

Reduction-Products of Mononitroazoxybenzol.—G. A. Schmidt.—It appears that the author had been engaged with researches on this subject some eight years ago, but had not then gone very deeply into it. Meanwhile it was taken up by various other experimenters, and among them, also, M. Alexejeff, who wrote and published a monograph on this subject in the Russian language. This circumstance induced the author to resume his work; and he proceeds with the reduction of the nitroazoxybenzol as follows :—One part, by weight, of that material is dissolved into ten parts of strong and boiling alcohol. While boiling temperature is kept up, there is gradually added a strong alcoholic solution of sulphide of ammonium, in small quantities of from 2 to 3 c.c. at once, and this is continued until all nitroazoxybenzol is dissolved, and none of it appears to crystallise out on a few drops being taken out of the boiling fluid as a test and cooled down. The formation of aniline and β phenyldiamin is in this way entirely prevented. To the liquid, after having been decanted from the precipitated sulphur, a mixture of weak spirit and excess of hydrochloric acid is added, whereby muriate of amidoazoxybenzol is formed; this is a solid substance, exhibiting crystalline form, and possessed of a violet-blue colour and metallic lustre. When to these yet impure crystals is added a little ammonia and weak spirit, there is obtained

a golden yellow-coloured crystalline mass, insoluble even in boiling water, but readily soluble in alcohol and ether; this pure material fuses at 127°. This muriate, or hydrochlorate, yields, on being treated with excess of ammonia, the amidoazoxybenzol, a solid substance fusing at 138·5°, composed according to the formula $C_{12}H_9(NH_2)N_2O$, nearly insoluble in cold water, a little soluble at the boiling point of that fluid, and readily soluble in strong alcohol, ether, and benzol.

On Trinitroazoxybenzol.—G. A. Schmidt.—When azoxybenzol is treated with a mixture of nitric and sulphuric acids, a trinitro product is obtained. The author mixed, in a flask, 20 grms. of azoxybenzol with 200 grms. very strong nitric, and 100 grms. of concentrated sulphuric acids. The azoxybenzol dissolves without giving off red vapours (but, becoming very hot, the mixture is to be poured into cold water immediately), and yields a bright yellowish crystalline mass, glued together by a resinous product. After having rubbed up with some water, and placed on a filter, washed, and dried, the resinous matter is dissolved, and thereby the trinitroazoxybenzol obtained as a crystalline powder, insoluble in water, very difficultly soluble in alcohol and ether, and readily soluble in benzol. It is best purified by re-crystallising it from nitric acid of 1·38 sp. gr., wherein it is readily soluble on being boiled, and crystallises on cooling. It fuses at 152°, solidifies at 140°, and explodes rather sharply when heated more strongly. Formula, $C_{12}H_7N_3O_7$. The resinous matter referred to contains binitroazoxybenzol, or isomeric substances, researches about which still occupy the author.

PATENTS.

Communicated by Mr. VAUGHAN, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1683. H. Holdrege, New York, U.S.A., "Improvements in the process of making gas for illuminating, heating, and other purposes, and in apparatus for the manufacture thereof."—Partly a communication from W. H. Gwynne, New York, and G. W. Harris, Elizabeth, New Jersey, U.S.A.—Petition recorded May 31, 1869.

2039. W. Pidding, Lambeth, Surrey, "Improvements in the mode or modes of obtaining scents, aroma, perfume, or essential oils, from flowers and from all vegetable substances producing the same; also in the machinery or apparatus in connection therewith."—July 6, 1869.

2328. J. T. Way, Kensington, Middlesex, "Improvements in the manufacture of soap, and in cleansing wool and woollen goods."—August 3, 1869.

2345. E. Beanes, Cordwalles, near Maidenhead, Berks, "Improvements in preserving articles of food."—August 5, 1869.

2413. D. Barker, Northfleet, Kent, "Improvements in the manufacture of artificial fuel."—August 12, 1869.

2418. D. A. Gibbs, Milton Street, London, "Improvements in compositions for coating or covering the sides and bottoms of ships and vessels."—August 13, 1869.

2431. W. Matt, Homerton, Middlesex, "An improved compound, or composition, in imitation of marble, veneer, and other substances, to be used in the manufacture of fancy and other articles."—August 14, 1869.

2440. H. Pinkus, Camden Town, Middlesex, "Improvements in furnaces and other heating apparatus, and in the methods of applying and using therewith certain elements of combustion, and in the combinations therewith of the processes, with materials to be used in the manufactures of metals, and other things and uses, and in the mechanical constructions necessary therefor."

2443. J. G. Dale and E. Milner, Warrington, Lancashire, "An improved method of producing white pigments from lead."—August 16, 1869.

2482. F. Braby, Euston Road, Middlesex, "Improvements in the means and apparatus for the manufacture of caustic ammonia and ammoniacal salts."—August 19, 1869.

2490. W. Byrne, Belfast, Ireland, "Improvements in the process of distilling alcoholic liquors, and in apparatus for that purpose.

2493. A. V. Newton, Chancery Lane, "An improvement in the process of manufacturing paint."—A communication from S. R. Bradley, New York, U.S.A.—August 20, 1869.

2500. P. A. Blake, Highbury, Middlesex, "A new or improved safety explosive compound or compounds to be used for blasting and other purposes, together with means connected with its use."—August 21, 1869.

2503. T. Gibb and C. Gelstharp, Jarrow-on-Tyne, Durham, "Improvements in the extraction of copper from its ores."—August 23, 1869.

NOTICES TO PROCEED.

1224. M. Henry, Fleet Street, London, "An improved mode of obtaining pyrophosphate of lime."—A communication from E. Deligny, Boulevard St. Martin, Paris.—Petition recorded April 21, 1869.

1290. S. Oakman, Boston, Suffolk, Mass., U.S.A., "Improvements in the construction of smelting and other furnaces."—April 26, 1869.

1380. W. Mackean, Paisley, N.B., "Improvements in the manufacture of cattle food."—May 5, 1869.

1486. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of beet-root and other pulps, and in machinery or apparatus employed therein."—A communication from H. Champonnois, Paris.—May 14, 1869.

2364. W. B. Newton, Chancery Lane, "An improved process for purifying or disinfecting alcohol and alcoholic liquors."—A communication from B. J. Maumené, Paris.—August 7, 1869.

2409. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of iron and steel."—A communication from J. J. Johnston, Allegheny, Penn., U.S.A.—August 11, 1869.

2501. J. Baur, New York, U.S.A., "Improvements in the manufacture of steel."—August 21, 1869.

NOTES AND QUERIES.

Solid Chloride of Carbon.—Could you kindly inform me of the method for preparing the solid chloride of carbon mentioned in the CHEMICAL NEWS (vol. xx., p. 130)? Could it be made from the tetrachloride of carbon?—H. BUTT.

Sulphate of Ammonia and Sulphuric Acid.—Can any of your readers inform me of a ready commercial method of determining the percentage of ammonia in sulphate of ammonia, and also tell me the readiest way to find out if pyrites has been used in the preparation of vitriol?—A. Z.

Gas Furnace.—Will any of your readers inform me if it is practicable, by means of an ordinary chimney draft, and gas from the main, to get up a white heat within a cylinder of some 2 ft. diameter and 4 ft. high (the cylinder would be fitted inside with objects for flame to strike against)? if so, I should feel much obliged.—J. C.

Simple Experiment Shewing that Air Possesses Weight.—Heat a little water in a flask until the air is purged out, and, while in this state, cork tightly, and set aside to cool. When cool, balance carefully in a good balance, or even ordinary scales; then remove the cork to admit air, and again weigh (including cork): the additional weight of air admitted into the flask will be sufficient to sensibly turn the scale.—W. NETTLETON, Huddersfield.

Terra Alba.—In answer to "Terra Alba," this article is not an artificial product, but the finest quality of gypsum stone that can be had, carefully ground to a powder. It is made principally in Derbyshire, and at Leith; it is used for many purposes; it never varies in quality, except according to the quality of the stone it is made from. There is an artificial terra alba, sold under the name of pearl hardening, and which is chemically the same, made by precipitation, under the patent of M. Jullien. It contains a larger quantity of water than the natural article. If it is too much dried, it is liable to lose part of its water of crystallisation, and, on addition of water, to set hard like plaster. If your correspondent applies to me, through you, I will give him every information he needs.—NEMO.

Octylic Alcohol.—In reply to your correspondent G. P. Clark, I beg to inform him that the best method of preparing octylic alcohol from castor-oil is the following:—Dissolve one part of caustic potash (or soda, which will do quite as well) in a small quantity of water, add two parts of castor-oil, and heat this mixture in a large iron pot until all frothing ceases, and a smell of mushrooms is given off. Introduce the solid mass thus obtained into the still, and conduct the distillation as quickly as possible. To purify the crude alcohol, it has to be rectified several times over fused caustic potash, the portion boiling below 200° C. only being collected. Besides higher boiling products, hydrocarbons having a lower boiling point are also present, and are easily removed by fractional distillation. Instead of using castor-oil, castor-oil soap may be used, which has first to be heated with caustic alkali, in an open vessel, as described above.—C. SCHORLEMMER, Owen's College, Manchester, September 11th, 1869.

TO CORRESPONDENTS.

*** It is our pleasing duty to accord our best thanks to those gentlemen who have so kindly acceded to our request in sending us the necessary information respecting the Chemical and Medical Schools for our Students' Number.

J. Cabitt.—You will find full particulars on the subject you name in Watts's "Dictionary of Chemistry," vol. v., p. 276.

L. W. Longstaff.—Dr. Roscoe's new work on spectrum analysis, published by Macmillan, is the most complete work on the subject.

W. Carslon.—Consult "Annaire Almanach de Commerce, de l'Industrie, de la Magistrature, et de l'Administration, ou Almanach des 500,000 adresses (Didot-Bottin), 72e année, 1869." You can see this work at the library of the Patent Office, and possibly at one of the libraries, or the French Consulate Office in Edinburgh.

W. Seddon.—(1) A number of works on this subject have been published; amongst them we may name "A Treatise on Coal and Coal Mining," by W. W. Smyth, M.A., F.R.S., &c. (Virtue); "Coal and Coal Oil," by Eli Bowen, Philadelphia, U.S. (Burat La Houille, Paris): several editions of this work have appeared. (2) Galvanic batteries are made so cheaply by philosophical instrument makers that it is scarcely worth while to make them; but any work on natural philosophy will give you sufficient information about their construction.

BOOKS RECEIVED.

Transactions of the Epidemiological Society of London, Vol. III., Part I. London: Hardwicke.

Canterbury Water Supply: Chemical Report. By Dugald Campbell, Esq., F.C.S. 1869.

American Reprint of the CHEMICAL NEWS for September, 1869.

Treatment of Human Excreta. By J. C. Lee. Manchester: J. Heywood.

THE CHEMICAL NEWS.

Vol. XX. No. 514.

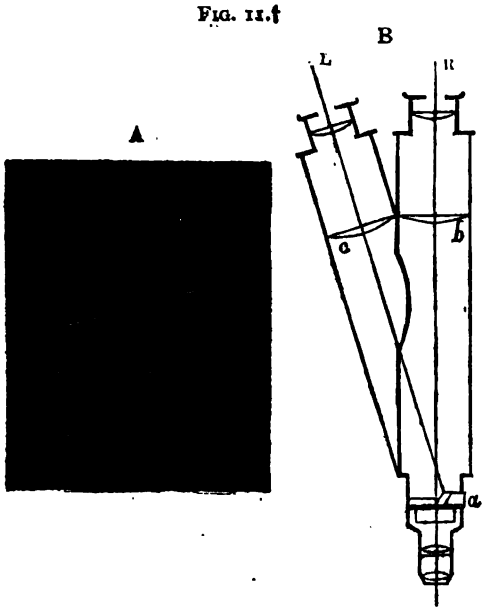
ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 149.)

A description of the compound achromatic microscope can, at the present time, hardly be considered complete without some mention of binocular instruments. The binocular principle had been applied to opera glasses with great success for many years. More recently the invention of the stereoscope and its great popularity drew increased attention to the subject of binocular vision, but until a few years ago no attempt seems to have been made to adapt the principle to microscopes. Owing to the short focal length of microscopical objectives, the use of two convergent instruments would of course be impracticable; the only resource was to divide the pencil proceeding from the object-glass and convey half to each eye. The earlier attempts resulted in the

Fig. 11.†



production of pseudoscopic instruments; that is, the relative positions of the object viewed were reversed projections, being represented by depressions and the contrary. This was found to be caused by the rays of light being conveyed to the wrong eyes, the right side of the image entering the right eye, and the left the left eye, the effect being that of a wrongly mounted stereoscopic picture. It was found necessary that the right-hand image should be conveyed to the left eye, and *vice versa*, to produce a stereoscopic effect; this was accomplished by M. Nachet of Paris, and Mr. Wenham by different methods, each having their respective merits. As Mr. Wenham's is most in use in this country, I will briefly describe it. A four-sided prism of peculiar form (Fig. 11, A) is placed in the body of the microscope, just behind the posterior combination of the object-glass (Fig. 11, B, *b*), which, when in position, it half covers. An additional body, L, is joined at a slight inclination to the left-hand side of the instrument, and the two bodies are furnished at their upper extremities with draw-tubes, which supply the means of making an adjustment for the varying distance between the eyes of different persons. The image formed by the left-hand half of the objective passes up the straight tube to the right eye without being in any way interfered with by the prism; the right-hand image falls on the prism, is twice reflected, and passes into the left-hand inclined tube, and in this simple manner the crossing of the images from the two sides of the objective is effected, only one-half of the pencil suffering any reflection at all, besides giving the great advantage of instantly converting the instrument into a monucular by simply withdrawing the prism. It is only due to Mr. Wenham to mention that he has, with most praiseworthy liberality, granted free and unconditional use of his valuable invention to the public.

The binocular arrangement of Mr. Wenham cannot be used with advantage with objectives of less than half an inch focal length, but several arrangements have been constructed by which both eyes can be employed in high power observations, the most noteworthy of which has been brought forward by Messrs. Powell and Lealand. This instrument does not produce any stereoscopic effect, but nevertheless greatly diminishes the fatigue of protracted observations. A still more perfect adaptation has been constructed by Mr. Wenham, in which the light in each tube has been more nearly equalised than in preceding instruments.

The stereoscopic binocular offers many advantages over the monocular instrument, not the least of which is the saving of the fatigue to the eyes from which most persons suffer in a greater or less degree when using one eye for observation. Did the binocular arrangement do no more than this it would be a great boon, but it has the valuable property of enabling the observer readily to estimate the amount of elevation and depression of the surface he is viewing, and accurately to determine the relative position as to depth of the various parts of the tissue under observation. The discoveries which we owe to this improvement of the microscope have been numerous and valuable; among the earliest were some interesting observations on the circulating system of the tadpole, by Mr. W. U. Whitney (*Trans. Micros. Soc. Lond.*, vol., x., 1862, p. 1; and vol. xv., p. 43). Several also by the late Richard Beck; among them the re-discovery of the aperture in the fang of the spider figured by Leeuwenhoek (Hoole's English Translation, vol. i., Pl. 2, fig. 19) (*Science Gossip*, 1866, p. 201).

By a slight variation of the form of the prism, Mr. Crouch has succeeded in constructing a microscope which can, by merely shifting the position of the prism, become stereoscopic or pseudoscopic at pleasure. This modification of the binocular will probably be of value in confirming certain doubtful points of structure, by giving a reversal of the parts in relief.

Further particulars respecting the construction of

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

† "The Microscope and its Revelations," by W. B. Carpenter, M.D., Figs. 19 and 20 (Churchill).

the microscope and the optical principles involved will be found in the "Microscope and its Revelations," by Dr. Carpenter, and "Manual of Natural Philosophy" by Mr. Charles Brooke.

The microscope being a costly instrument, it is necessary that great care should be taken to preserve it from injury. When out of use it should be returned to its case or may be conveniently covered with a large shade or bell-glass. The eye-pieces should be carefully cleaned, as dust upon them becomes very apparent. The object-glasses, if kept in their boxes when out of use, will seldom require much cleaning; dust on the object-glass only causes a slight loss of light, but does not make itself visible. The best material for cleaning lenses is a piece of very soft wash-leather from which all dust has been beaten out; it should be kept in a large pill-box when out of use to preserve it from dust and grit, and should on no account be used for any other purpose, such as cleaning the brass-work of the instrument. Should the object-glasses require anything beyond mere dusting, they should be placed in the maker's hands as they are liable to injury if taken to pieces by inexperienced persons.

The sources of light for the purposes of observation will need a few remarks. When it can be procured, daylight is in every respect to be preferred to artificial sources of illumination, as by it alone can colours be perfectly seen and distinguished, and daylight observations are far less fatiguing than those made by lamp-light. Direct sunlight should be avoided, and, if possible, the light taken from a white cloud. But in towns, as the sky is seldom visible, and, moreover, few persons have much time to observe by daylight, it becomes important to seek for a good source of artificial light.

Gas has been used by many microscopists; it has the disadvantage of giving out a large amount of heat, and the quality of the light is inferior to that obtained from most other sources; its sole advantage is its convenience, as it is always ready for use, and requires no trimming, as is the case with lamps.

Well constructed lamps burning colza oil give a light of good and pure quality, although not as intense as those presently to be described. The best oil lamp I have used was obtained from Mr. Pillischer, and was only abandoned for the very intense camphine lamp. Oil-lamps require great care in trimming and cleaning, otherwise they will not burn well.

The mineral oils (paraffin, belmontine, &c.), when of good quality, and consumed in properly constructed lamps, are among the best of the microscopist's means of illumination. The quality of the light is good, and there is very little trouble required in keeping the lamp in good working order. The glasses, as in all lamps, should be kept clean, otherwise much light is lost, and to obtain the best possible effect the lamp should be trimmed each time of using, although it will burn very well two or three times without any attention. The best way of obtaining a good oil is to try small samples from various shops, and when a good one is found keep to its use. The burner exercises a very great influence upon the light, so great that in a series from various makers it would hardly be supposed that they were burning the same oil. The burners of American make supplied by Mr. Collins with the Bockett microscope lamps (Fig. 12), are some of the best that I have met with. This lamp has recently been improved by the adaptation of a metal chimney which is not liable to breakage, and also has the advantage of protecting the eyes of the observer from the light.

The best light of all for those who do not mind the slight amount of trouble attending its use is obtained from the combustion of camphine or highly rectified spirits of turpentine in a small lamp, especially constructed for the purpose by Mr. W. Young. The light is much whiter and more intense than that of any other lamp; owing to this quality the flame can be very much reduced in size, and most of the heat of a large lamp avoided, a matter of importance where the lamp is often placed near and below the face of the observer.

Camphine, when not used quickly, should be kept in small bottles, filled up to the neck, and closely corked, and kept in a cool place—a wine-cellar answers admirably. For the small consumption of the microscope lamp the bottles should not exceed four or five ounces, as the spirit rapidly deteriorates by exposure to the air both from evaporation and the absorption of oxygen, which renders it liable to clog the wick and reduces its illuminating power. The wick should be cut very exactly to a level, far more carefully than would be required for oil or paraffin, the least uneven point rendering the lamp liable to smoke. No more camphine than is likely to be consumed should be placed in the lamp; if there is more than is needed it should be allowed to burn itself out, or be thrown away, and the wick allowed to burn dry, otherwise the lamp is liable to become clogged, and burn badly. Should any part of the lamp become incrusted with a resinous deposit, it must be cleaned with methylated spirit; care should be taken that none of the air passages are obstructed. Although these precautions may seem troublesome, they really are not so to persons willing to acquire the habits of neatness so necessary to those who would make good microscopists; and the slight extra trouble is amply compensated by the superior purity and intensity of the light and its extreme cleanliness, it being perfectly free from greasiness or disagreeable smell. As the lamp is always kept empty it is very convenient for carrying about when it is necessary to make observations away from home.

Fig. 12.

The illuminating apparatus commonly supplied with microscopes consists of the mirror below the stage, and a condensing lens either attached to the instru-

ment or, as is to be preferred, on a separate stand. Other apparatus will be described in subsequent chapters.

The mirror is used for illuminating objects by directing light through them from beneath the stage, and is the usual, although not always the best, means of lighting an object, as it is one which we are unaccustomed to, and, without special precautions, is likely to lead into error. The mirror is capable of being moved out of the axis of the instrument, and light may be directed very obliquely upon the object, which is sometimes advantageous.

The condensing lens is used to concentrate light upon the object from above, and, when it can be employed, it is always preferable to commence an observation in this way rather than by means of transmitted light, as it accords more closely with our every-day way of viewing objects: it is not our usual custom to hold up a substance we wish to examine and try to look through it, but we generally allow the light to fall naturally upon it. If a plano-convex lens, or "bull's-eye," be used as a condenser, it is necessary to be careful which side is turned to the source of light, otherwise it may be used in a position causing a great amount of spherical aberration and consequent loss of light. A plano-convex condenser should always have its curved side turned to the source of light when used for concentrating light upon an object. When used for rendering divergent rays, such as those of a lamp, parallel, which is often required when using apparatus hereafter to be described, the bull's-eye should be placed with its flat side to the lamp and at about the distance of its focal length.*

The beginner is recommended to commence his observations by endeavouring to procure a good and brilliant illumination with the condensing lens, looking at any easily procured objects, such as fragments of paper, feathers, sand, &c.; a hummingbird's feather or wing of a butterfly is particularly useful, as either of them presents very different appearances, according to the direction of the illuminating pencil, the iridescent colours of the first and the imbricated structure of the second not being seen unless the light is made to fall in the proper direction. The light should be moved or the object turned round, and the varied appearances carefully noted. This precaution should be adopted with all objects viewed by reflected light.

In commencing observations by transmitted light, the student may profitably examine air-bubbles in water, easily procured by shaking up a little very weak gum-water in a bottle, and also globules of oil in water, of which milk furnishes a good and readily-procured example. A little of each of these should be placed on a separate slide, covered with a thin glass and examined by transmitted light, the air-bubbles with an inch objective; the milk may probably require a ½ or ¼.

The leading characteristic of the air-bubble is its broad black margin when examined by transmitted light. If the laws of refraction are considered, it will be evident that a bubble of air in water will act precisely as a double concave lens, Fig. 4, B, and by its dispersive power scatter the rays of light, especially at the part where its power is greatest—the margin. The same effect may be produced, on a large scale, by holding to the light two plano-concave lenses of glass with their hollow sides placed together; this will almost exactly represent the air-bubble in water, differing only in the glass having a greater refractive power than the water in the microscopic slide, and dispersing the light rather more powerfully.

The oil globules of the milk exhibit a brilliant spot of light in their centre when slightly beyond the focus of the microscope; this is owing to their being more refractive than the surrounding medium: their action is that of double convex lenses, Fig. 4, A, and the bright spot is an imperfect image of the source of illumination, which is rendered visible when the focus of the microscope coincides with that of the globule, which will be when the instrument is slightly above the focus for distinct vision of the globule.

These appearances should be carefully studied and remembered, as bubbles of air are among the most frequent of the instrusive substances to be met with during microscopical observations; cells filled with oil and globules of oil are also of frequent occurrence in tissues. Besides these, the student should make himself acquainted with the microscopical appearance of fibres of cotton, wool, flax, &c., hair of cats and other animals, all of which are frequently found in the dust of our apartments, and of course in our microscopical preparations, unless more than ordinary care is taken to prevent their intrusion, so that it is well to know them that they may not be mistaken for characteristic portions of the substance under observation, a not unlikely error on the part of inexperienced observers.

A sample of dust from the walls of an office in the Bank of England, where it had accumulated for more than ten years, consisted of about one-half cotton fibre, probably derived from abrasion of paper; the remainder consisted of fibres of wool and flax in small quantities, and soot and grit; molecular motion was apparent when examined in water with a power of 400 diameters. An interesting paper "On the Microscopical Examination of Dust" was read by Mr. J. B. Dancer before the Literary and Philosophical Society of Manchester, January 26th, 1869.

(To be continued.)

* Each lecture was followed by a practical demonstration, during which various objects, &c., were examined and processes in manipulation carried on under the superintendence of the lecturer and assistants. Much of the subject-matter of these demonstrations will be incorporated with the text; such portions as cannot be so given will be added at the end of the various chapters.

ON THE

DETERMINATION OF CRYSTALLISED SUGAR.

By JAMES BELL, Esq.

Two processes for the determination of crystallised sugar have been proposed, one by M. Dumas, and the other by M. Payen. Both methods are based on the insolubility of crystallised sugar in alcohol saturated with refined white sugar, while inverted and uncrystallised sugars are supposed to be soluble therein.

These two processes, while differing in many important particulars, are essentially the same in the method followed in liberating the crystallised sugar, which consists in mechanically washing out, by simple agitation, the inverted and uncrystallised portion. This method of operation may be adapted for the analysis of superior qualities of sugar, but it is not applicable to low descriptions, such as "jaggery" and "concrete," or to mixtures of sugar and treacle.

In the analysis of "jaggery" and "concrete," &c., simple agitation in the test liquor is not sufficient to dissolve out, and remove the whole of the inverted and un-

crystallised sugars, and liberate the crystallised portion. When the proportion of inverted and uncrystallised sugars present is tolerably large, the sample possesses a considerable degree of tenacity, and, it is not practicable, by simple agitation, to reduce it into that minutely divided state which is essential to admit of the solvent power of the test liquor being brought into full action; and in practice, in order to effect a complete disintegration of the sugar, it is necessary to operate in a mortar, and to gently rub the sample in the test liquor with a pestle.

The alcohol employed in both Dumas's and Payen's processes is of a strength of 85°, or a little under 50 over proof strength, and, prior to saturation, there is added to the alcohol five per cent of acetic acid, for the purpose of decomposing and dissolving any salts of lime, &c., that may be present.

Before submitting the sample to the action of the test liquor, M. Payen removes the "2 or 3 per cent" of moisture it contains by "absolute alcohol." It is obvious that this could not be done with samples containing large percentages of treacle, such as those to which the process hereafter described is applicable, as the "absolute alcohol" could not abstract the water from them, on account of their viscidity, and even if it were possible for it to do so, the reduction in strength would be so considerable that the alcohol would have a very appreciable solvent action.

The strength of the alcohol has a very important influence upon the accuracy of the result, and, while it is desirable to keep the strength as high as possible, that the alcohol may be readily saturated with a small quantity of crystallised sugar, and that a slight reduction in strength will not materially increase its solvent power, it is, on the other hand, essential that the alcohol should be of such a strength that the proportion of the test liquor used for washing the sample will be sufficient to dissolve the whole of the inverted and uncrystallised sugars present.

Alcohol, at the higher strengths, has a very limited solvent power for sugar; but its power for dissolving the sugar increases in a greater ratio than its reduction in strength. For example, at a temperature of 60° Fahr., 100 grains of alcohol by measure of the respective strengths of 62·6, 55·7, and 49·6 over proof dissolve 0·52, 1·34, and 2·94 grains of crystallised sugar respectively. It will thus be seen that, from 62·6 to 55·7 over proof, a reduction in strength of 6·9°, the solvent power of the alcohol is increased by only 0·82 of a grain, or 0·12 of a grain for each degree of reduction in strength, while from 55·7 to 49·6 over proof, a reduction in strength of 6·1°, the solvent alcohol is increased 1·60 grains, or 0·26 of a grain for each degree of reduction, being more than double the ratio of the increase from 62·6 to 55·7 over proof.

In like manner, the solvent power of alcohol for inverted sugar increases with its reduction in strength, but not in an increasing ratio, as in the case of crystallised sugar; on the contrary, the ratio of increase appears to be a diminishing one.

It is necessary to bear these facts in mind in selecting alcohol of the most suitable strength for preparing the test liquor. If the alcohol be of a very high strength, the result will show a higher percentage of crystallised sugar than is known to be present; but, on the other hand, if the alcohol used be of a very low strength, there will not only be considerable difficulty in fully saturating it with cane-sugar, but the result will be a much less proportion of crystallised sugar than there should be.

This may be illustrated by the following results obtained from experiments, made upon the same mixture of refined sugar and treacle, with test liquors prepared from alcohol at each of the strengths specified.

		Percentage of crystallised sugar.
1.	Alcohol of 40 over proof gave	49·20
2.	„ 56 „ „	54·49
3.	„ 63 „ „	64·70

The result obtained in No. 2, by alcohol of 56 over proof strength, is within a few tenths of the quantity of crystallised sugar known to be present. The large excess in No. 3 is doubtless due to the very limited solubility of inverted and uncrystallised sugars in alcohol of that strength, and the consequent difficulty of dissolving the whole of these sugars in a given number of washings, and thus liberating the crystallised portion. In No. 1 there is a considerable deficiency, which is probably due to the water in the sample having increased the solvent power of the alcohol at that strength in a greater ratio than in the other cases at the higher strengths. The additional quantity of crystallised sugar, however, which the reduced test liquor dissolves, is not, as a rule, in proportion to the reduction which the quantity of moisture in the sugar would make in the strength of the alcohol, a circumstance which is due to the fact that the time the test liquor and the sugar are in contact is too short to allow the former to become completely saturated.

After making a variety of experiments, it soon became obvious that the most suitable strength of alcohol to be used for preparing the test liquor lay between 50 and 56 over proof; but that it could not be absolutely affirmed that alcohol of any particular strength was applicable to the analysis of all descriptions of sugar, ranging from the finer qualities down to molasses.

To ascertain the relative value of alcohol at the strengths of 56 and 50 over proof for preparing the test liquor, a mixture was made, consisting of 60 parts of purified white sugar and 40 parts of treacle; and experiments were made on the mixture with saturated alcohol at each of the strengths named, with the following results:—

	Percentage of crystallised sugar.
Alcohol of 56 over proof gave	59·12
„ „ 50 „ „	57·72

Thus, with alcohol of a strength of 56 over proof, there was a loss of 0·88 of crystallised sugar; but, with the alcohol of 50 over proof, the loss amounted to 2·28 grains, or nearly 2½ per cent more than in the case of the alcohol of the higher strength.

The test in this case was very rigid, and, upon this ground, as well as from a slight loss which must inevitably occur in manipulation, the loss of the 0·88 of crystallised sugar with the alcohol of 56 over proof strength may be accounted for. With refined sugar, it is not only difficult to obtain an intimate and uniform mixture of the crushed crystals and treacle, but the crystals remain exposed, as it were, to the immediate action of the first portion of the test liquor, which acquires increased solvent power from the additional moisture which it takes up from the sugar.

The sample of treacle employed in the preparation of the mixture was found to contain 3·35 per cent of salts and other impurities insoluble in the test liquors; and, in calculating the results, an allowance was made for the proportion of insoluble matter contained in the quantity of treacle used in the experiments.

To determine whether a test liquor prepared from alcohol of a strength of 56 over proof would give uniform results with mixtures of crystallised and inverted sugars in all proportions, mixtures were made of treacle and raw sugar, varying from 10 to 90 per cent of each; and the several mixtures were submitted to careful analysis, and the same conditions observed in every instance. Three analyses were made of each mixture, and also of the raw sugar, and a mean of the results taken.

The raw sugar used was of medium quality, and gave 84·69 per cent of crystallised sugar. The treacle employed was the same as that used in the experiments referred to above; and, in each instance, the proper allowance was made for the proportion of salts and other impurities insoluble in the test liquor.

The mean results of the analyses made of the respective mixtures were as follows:—

					Percentage of crystallised sugar by calculation.	Percentage of crystallised sugar by experiment.	Loss. Gain.
90 parts of sugar and	10	of treacle			76·22	75·80	0·42
80	,,	,,	20	,,	67·75	67·84	0·09
70	,,	,,	30	,,	59·21	59·71	0·43
60	,,	,,	40	,,	50·81	51·44	0·63
50	,,	,,	50	,,	42·34	43·65	1·31
40	,,	,,	60	,,	33·87	36·01	2·14
30	,,	,,	70	,,	25·40	28·01	2·61

From the results of the experiments, it will be seen that, as the percentage of treacle is increased (the percentage of moisture being also thereby proportionately increased), the residue, contrary to what might have been expected, indicates a small but gradually-increasing excess over the percentage of crystallised sugar known to be present. This cannot be due to the salts and other impurities in the treacle which are insoluble in the test liquor, for they, as before stated, have already been allowed for. It is highly probable that it is caused by the increasing viscidity of the mixtures and the consequent difficulty of the alcohol, limited in quantity, and approaching nearer and nearer to its saturating point for inverted and uncrystallised sugars, in effecting the liberation of the crystallised portion.

The results obtained in the analysis of the mixtures containing 80 and 90 per cent of treacle respectively were considerably in excess of the quantity of crystallised sugar present; and it was obvious that the test liquor was inapplicable to the analysis of mixtures containing so large proportions of treacle.

The results accord very well with the theoretical percentages of crystallised sugar in the mixtures down to 50 per cent, but, from this point, the results are not so satisfactory as could be wished.

In the analysis of samples of sugar or mixtures of sugar and treacle in which the proportion of inverted and uncrystallised sugars amounts to upwards of 50 per cent, a test liquor prepared with alcohol of a slightly lower strength than 56 over proof is more suitable, and gives more accurate results; in fact, by gradually reducing the strength of the alcohol, and employing a fresh test liquor as the scale is descended, practically accurate results may be obtained down to the lowest mixture, consisting of 90 parts of treacle to 10 of sugar.

The mode in which the analyses were conducted may be shortly described. To alcohol of the proper strength, excess of finely-powdered purified white sugar was added, and the mixture was agitated for two or three days, and, as required for use, the clear saturated liquid was drawn off. 100 grains of the sample were then gently rubbed in a mortar with 200 fluid grains of the saturated alcohol, and the washings thrown upon a filter previously counterpoised with another filter. The operation of washing was repeated nine times, with the like quantity of fluid grains, the sugar in the mortar being gradually transferred to the filter, so that, when the 2000 grains of the test liquor were used, the whole of the sugar had been transferred to the filter. The counterpoised filter and that containing the crystallised sugar were then dried in a water-bath, and the difference in the weights, after allowing for the salts, &c., present in the treacle, and insoluble in the test-liquor, gave the percentage of crystallised sugar in the sample.

My best thanks are due to Messrs. Helm and Stokes for the valuable assistance which they rendered me in making the experiments connected with this investigation.

Permanent White, which is necessary in the manufacture of ultramarine, may be formed by adding to the washing waters of that dye sufficient chloride of barium to render the liquid no longer turbid. The precipitate, which is heavy, and falls quickly, may be deprived of a bluish tint by depositing a portion first, with which the ultramarine held in suspension also settles.

ON THE ACETIC DERIVATIVES OF HYDROCARBONACEOUS SUBSTANCES.

By MM. SCHUTZENBERGER and NAUDIN.

ACETIC anhydride reacts easily upon many immediate organic principles, playing the part of polyatomic alcohols. The total transformation of bodies into acetic derivatives is thus quickly effected, the degree of substitution varying according to the temperature and the quantity of the anhydride. Here are the results of my experiments.

Acetic Celluloses.—The cellulose (Swedish paper or cotton) was heated to 180° in a closed vessel with six or eight times its weight of acetic anhydride. It dissolved into a thick syrup, which, when poured into water, precipitated white flakes of triacetic cellulose—

$$C_6H_7(C_2H_3O)_3O_5,$$

insoluble in water, alcohol, or ether; soluble in concentrated acetic acid; easily saponifiable by alkalies, with regeneration of cellulose. Whatever the duration of the heating process or the excess of anhydride employed, no higher limit was reached. Cellulose is, then, a triatomic alcohol—

$$\left.\begin{matrix} C_6H_7O_2 \\ H_3 \end{matrix}\right\} O_3$$

On employing but two parts of anhydride, and heating to only 150°, the cotton swelled without dissolving, by reason of the simultaneous production of diacetic and monoacetic ethers, which could not be separated.

Starch and Dextrine.—Starch, when heated to 140° with excess of acetic anhydride, swelled greatly without dissolving. The mass, when washed with water, yielded a white, amorphous substance, insoluble in water, alcohol, ether, and acetic acid; not turned blue by iodine, and saponifiable by caustic alkalies, with regeneration of starch, turning blue by iodine. It represents triacetic starch $C_6H_7(C_2H_3O)_3O_5$. If the mixture of starch and acetic acid be heated to 160°, the swelled mass will dissolve, yielding an amber syrup. This, when poured into water, precipitates a white, amorphous matter, insoluble in water, alcohol, and ether, but soluble in glacial acetic acid. It is easily saponified by alkalies, with separation of dextrine. Its composition is the same as the preceding, and represents triacetic dextrine obtained directly by the action of the anhydride upon dextrine. The degree of substitution of the third order cannot be passed; those inferior were not examined, on account of the difficulty of distinguishing them. Starch and dextrine act, therefore, as triatomic alcohols.

Glycogene.—Glycogene, when heated at 155° with excess of acetic acid, swells without dissolving. The mass, washed in water, gives an amorphous, white product, insoluble in water (even warm), and in alcohol, ether, and acetic acid. It is saponified by alkalies, with regeneration of glycogene. It represents the maximum of saturation, and is triatomic—$C_6H_7(C_2H_3O)_3O_5$.

Gum Arabic.—This substance, when heated with about two parts of acetic anhydride to 150° for some hours, swells without dissolving. The mass, washed first with boiling water and then with alcohol, leaves an amorphous white powder, insoluble in boiling water, and saponified by alkalies, with regeneration of soluble arabin. It represents diacetic arabin, $C_6H_8(C_2H_3O)_2O_5$. By employing an excess of 6 to 8 parts of acetic anhydride, and heating to 180° for five or six hours, a triacetic derivative is obtained, similar in its properties to the preceding one: this is the highest degree of substitution.

Inuline.—This yields, under the same conditions, a saturated, triacetic derivative, soluble in water, of a bitter taste, and melting, at about 110°, into a syrup which solidifies into a vitreous, transparent, and colourless mass. It is easily saponified by alkalies, with regeneration of a white body, insoluble in water, and which melts below

100°. Thus, cellulose and its isomers of the formula $C_6H_{10}O_5$ all give saturated derivatives of the third degree, easily distinguishable from each other by their character of solubility and the nature of the products generated by saponification.

Acetic Derivatives of Sugar.—The action of acetic anhydride on sugar is vigorous: the reaction begins at the instant when the acid boils, and ends of its own accord in a few moments, with great development of heat. The sugar was heated for twenty-four hours at 170° with large excess of anhydride. Alkalies could not here be used for decomposition on account of their ulterior action upon sugar, but it was easily effected by water only at 160°.

Acetic Glucose.—One part of dry glucose, heated to the boiling point of the acetic anhydride with 2½ parts of the latter, in an open vessel, gives a lively reaction, ending in a few moments. The product, when suitably purified, is solid, colourless, and of a bitter taste. It is soluble in water, alcohol, ether, and acetic acid, and melts below 100°. Its analysis corresponds with the formula for diacetic glucose, $C_6H_{10}(C_2H_3O)_2O_6$. This substance, when again heated to 140° with about twice its weight of anhydride, yields a second solid derivative, distinguished from the first by its slight solubility in pure water. It dissolves in water containing acetic acid, in alcohol, and ether, and represents triacetic glucose. This latter, maintained at 160° for twenty-four hours with a large excess of anhydride, changes into a saturated product very similar to the preceding, but differing by its insolubility in water charged with acetic acid. The acetic liquid, poured into water, yields a viscous precipitate, which is washed with water, again dissolved in alcohol containing bone-black, filtered, and evaporated to dryness. Its composition, which is ascertained by combustion and estimation of the acetyle, is that of tetracetic glucose, wanting a demi-molecule of water, and answers to the formula $C_{12}H_{14}(C_2H_3O)_8O_{11}$. The more simple formula, $C_6H_6(C_2H_3O)_4O_5$, may, perhaps, be employed, but it does not tally so well with the results of the analysis. Under these conditions, glucose undergoes a partial dehydratation. Cane-sugar yields, under similar circumstances, a saturated derivative, undistinguished in character or composition from the preceding. (The rotatory power was not studied).

Lactine, heated to 140° with acetic acid, dissolves entirely. The liquid, when poured into water, yields a viscous precipitate, which quickly becomes powdery. Acetic lactine softens at about 52°; its composition corresponds with the formula $C_{12}H_{14}(C_2H_3O)_8O_{11}$, or $C_6H_6(C_2H_3O)_4O_5$.—*Comptes Rendus.*

ON THE

OXIDATION OF PHOSPHORUS

AND THE

QUANTITY OF PHOSPHORIC ACID EXCRETED BY THE KIDNEYS IN CONNECTION WITH ATMOSPHERIC CONDITIONS.*

By J. MOFFAT, M.D., F.R.A.S., F.G.S.

FROM results deduced from observations on the luminosity of phosphorus in connection with atmospheric conditions for a period of six years, it appears that periods of phosphorescence and ozone periods commence, continue, and terminate under the same atmospheric conditions; that phosphoric ozone is formed only when phosphorus is luminous, and that increase of temperature and low atmospheric pressure are favourable to luminosity, while low temperature and high atmospheric pressure are unfavourable to it.

While the readings of the barometer are increasing and the wind is veering towards the N. points of the compass, phosphorescence diminishes in brilliancy and ozone in quantity; and, while the polar current continues, the barometer attains its maximum, the wind veers from N. to E., phosphorus becomes non-luminous, and ozone disappears. If, when the wind has veered to the E., the barometer readings begin to decrease, the wind sets in from points by S., phosphorus becomes luminous, and ozone appears; and, while the south or equatorial current continues, the barometer readings fall to a minimum, the wind veers from S. to W. points, phosphorescence becomes brilliant, and ozone is in maximum quantity. Liquid and gaseous bodies, when in contact with phosphorus in a non-luminous state, become phosphorated, and they, under suitable conditions, become phosphorescent and ozonised, the temperature at which phosphorescence takes place varying with the pressure of the atmosphere.

As venous blood contains phosphorus (phosphorated fat), which, in coming in contact with the oxygen of the air during respiration, is converted into phosphoric acid (the blood, perhaps, being ozonised at the same time), and combines with the alkalies and earths in the *liquor sanguinis*, and forms phosphates of soda, magnesia, and lime, it appeared to me not unreasonable to suppose that the quantity of phosphorus oxidated and phosphates formed in the system, and eliminated from it through the kidneys, is in some degree determined by the pressure and temperature of the atmosphere, and the state of the weather generally.

With a view to ascertain the quantity of phosphoric acid excreted by the kidneys, I tested the urine of a healthy man daily for twelve months. The quantity of urine evacuated in twenty-four hours was measured daily, and the quantity of phosphoric acid in one ounce of it ascertained. The man was of abstemious habits; his food seldom varied in kind or quantity. It consisted of tea, bread-and-butter, eggs, animal food, rice, oatmeal, and milk. The two articles in excess were bread and milk; of the latter he took at least 3 pints daily. The readings of the barometer and thermometer, the quantity of atmospheric ozone, and the direction of the wind, were recorded daily. The results were deduced monthly, and tabulated as below.

TABLE I.

Showing the Mean Daily Quantity of Phosphoric Acid Excreted by the Kidneys when—

The barometer was				Temperature was		Ozone was		Phosphorus was		The wind was			
Increasing.	Decreasing.	Above 30 in.	Above 29 in., below 30 in.	Above 28 in., below 29 in.	Increasing.	Decreasing.	Present.	Absent.	Luminous.	Non-luminous.	N. to E.	E. to S.	S. to W.	W. to N.
grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.
58·8	62·8	53·6	57·5	67·5	62·4	61·4	62·0	56·0	60·0	57·0	56·8	59·5	62·0	61·4

From these results, then, it would appear that the maximum quantity of phosphoric acid excreted from, and in all probability formed in, the system occurs with the conditions of the equatorial or south and ozoniferous current of the atmosphere, and that the minimum quantity occurs with the conditions of the polar or north and non-ozoniferous current. The results of the observations for each month were similar to those in the table, with the exception of March and May. In March, there were 2 grains more of daily mean with increasing than with decreasing readings of the barometer; and, in May, the quantities were equal for both sets of readings. The range of the barometer, for March and May, was 1·247 in. only; while, for August and November, the range was 1·532 in.; and the difference in the quantities of phosphoric acid excreted was a daily mean of 12 grains more with decreasing than increasing readings. When the

* Read before the British Association, Exeter meeting, Section B.

range of the barometer for the month is above 1·5 in., the difference in the two sets of readings is 6·8 grains more with decreasing than increasing readings; and, when the range is less than 1·5 in., the mean difference between the two sets of readings is 3·4 grains more only for decreasing than increasing readings.

During the months from October to February (both inclusive), that is, during the months in which the temperature of the air is owing more to atmospheric than solar influence, a piece of phosphorus was kept in a dark cellar. It was examined daily, and the quantity consumed or oxidised was ascertained monthly. The results are given in the following table:—

TABLE II.

Showing that, when the Mean Monthly Reading of the Barometer was—

Between	The quantity of phosphorus oxidised was	The mean daily quantity of ozone was	The No. of ozone days was	The mean daily quantity of phosphoric acid excreted was
in.	grs.			grs.
29·0 and 29·5	41·3	2	18	62·5
29·5 ,, 30·0	20·0	1	8	55·6

From this, it would appear that the amount of phosphorus oxidised in the air and the amount oxidised within us depends upon similar atmospheric conditions. The readings of the barometer which lead to the issuing of cautionary (Admiral Fitzroy's) telegrams are, of course, decreasing.

I have observed that 94 per cent of the telegrams are accompanied by the commencement of periods of phosphorescence. Atmospheric ozone invariably appears or increases in quantity with them. The mean daily quantity of phosphoric acid excreted by the kidneys on the day before the telegrams is 65·3 grains; and, on the day of it, 63·9 grains; giving a mean of 64·6 grains, which is 3½ grains daily above the mean.

The diseases which accompany the meteorological changes which appear to lead to the foregoing results I leave for future discussion.

Hawarden, July, 1869.

NOTICES OF BOOKS.

Field's Chromatography, or Treatise on Colours and Pigments as used by Artists. A new edition, re-written by THOMAS W. SALTER, F.C.S. London: Winsor and Newton, 38, Rathbone Place. Pp. 435; 8vo.

WE have, unfortunately, too many examples of the disastrous effects which ensue from the use of certain colours by artists who are unaware of their nature and durability. Many a grand and immortal work of art has suffered irretrievably from the fading of some paints, and the blackening of others, and the effects of damp and impure air upon others. Sometimes colours slowly react upon each other: sometimes bright lead colours pass, in the course of years, into the dingiest of greys, ultimately becoming almost metallically black from the sulphur of the air by which they are surrounded. Now, with all this in view, the appointment of a Lecturer on chemistry to the Royal Academy of Arts has been more than once seriously discussed, and we may hope that, sooner or later, will be carried into effect. In the same direction, and tending to remove such like conflictions of chemical with artistic lore, is Field's "Chromatography;" and we are happy to welcome a new and revised edition of it. Fortunately, its reviser, Mr. Salter, is a chemist; so that artists have already within their grasp a certain application of chemical knowledge to the usages of their craft.

In the preface to this new edition, Mr. Salter informs us that the work has been entirely revised and re-written, "the notices of colours have been considerably extended, their chemical and artistic properties more fully dilated on, and many new pigments of the utmost importance described." Mr. William Winsor was engaged upon the revision of this work at the time of his death, and his *collaborateur* regrets that the intimate knowledge of colours which Mr. Winsor possessed can no longer be applied to the purposes of the revision.

The "Chromatography" is divided into three parts—Part I. "On Colours and Colouring;" Part II. "On Colours and Pigments generally;" Part III. "On Colours and Pigments individually."

In the first chapter, an infinitely too brief history of the prominent phases in painting is given, and allusion is made to the early works of the Egyptians and Greeks. There are, it is asserted, in reality, but three schools of painting—the *Material*, the *Sensible*, and the *Intellectual*. "Modern art, as founded upon the *intellectual* school of the ancient Greeks, became grand, scientific, and severe in the practice of Michael Angelo and Leonardo de Vinci; graceful, beautiful, and expressive in Raphael, Correggio, Dominichino, and Guido; and, aiming at *sensible* perfection, it attained harmony of colouring and effect in the works of Titian and Tintoret; but it sunk into grossness and sensuality while perfecting itself *materially* among the Flemish and Dutch." This is indeed a sweeping survey, so sweeping that no mention is made of the French or Spanish schools. We would not ask it for ourselves, for it is so recently that anything like an English school of painting—and that a mongrel and a bastard offspring—has arisen, that we can well make no demands for recognition; but surely, in the above statement, the name of Fra Angelico de Fiesole should come in between Raphael and Correggio; nay, we know not whether he should not be placed at the head of those painters who brought art to its culminating point in regard to the graceful, the beautiful, and the divine. What shall we say to those glorious angels, with wings sprinkled with golden stars, who are ascending jubilantly upon the purple clouds which curl at their feet? Or what shall we say to the serene and infinitely majestic and calm S. John, seated upon the outspread wings of an eagle? The art of to-day is as far behind the art of that day as the science of to-day is in advance of the science of that day. We always think that picture must have reference to Fra Angelico in which we see a monk who, seated in front of his painting, has fallen asleep over his work, while an angel, taking the brush from his fingers, continues that which he has left undone.

Passing on now to the third chapter, which commences Part II., we find some very useful definitions; for example, "By mixing his colours with white, the artist obtains his *tints*. By mixing colours with colours, he produces compound colours, or hues; and, by mixing colours or tints with black, he gets *shades*." Colours themselves are divided into five classes; the Neutral, the Primary, the Secondary, the Tertiary, and the Semi-Neutral. Neutral colours are *black*, *white*, and *grey*. Primary colours are *yellow*, *red*, and *blue*. Secondary colours are *orange*, *green*, and *purple*. Tertiary colours are *citrine*, *russet*, and *olive*. Semi-neutral colours comprehend all the combinations of primary, secondary, and tertiary colours, with the neutral black.

In regard to the "durability and evanescence of pigments," we have a good deal of useful information in chapter 4. The organic colours are most easily affected by light and air; compounds of lead, mercury, and copper by air containing sulphuretted hydrogen. Many colours are altered by the action of lead pigments, and others, again, by ferruginous pigments; finally, the vehicles and varnishes with which colours are mixed often act deleteriously upon the colours.

No less than seven-eighths of the work are devoted to colours and pigments individually considered; and we have here a long list of colours, with an account of their composition and general qualities: let us take the fol-

lowing as an example of the mode of description here employed:—"Burnt carmine is the carmine of cochineal partially charred, until it resembles, in colour, the purple of gold, for which, in miniature and water-painting, it is substituted. It is a magnificent reddish purple, of extreme richness and depth, eligible in flower painting and the shadows of drapery. As it is generally impossible, however, to alter the nature of a pigment by merely changing its colour, burnt carmine is scarcely more permanent than the carmine from which it is produced. If used, therefore, it should be in a body, and not in thin washes, or as a glaze. Durable pigments are admissible in any form; but semi-stable pigments (gamboge excepted) should only be employed in body."

We are glad to notice that descriptions of new pigments have been introduced; thus we have aureolin, thallium red, tungstate of baryta, viridian, brun de mars, indium yellow, and molybdenum green.

The "Chromatography" cannot but prove most valuable to all who are interested in art; and we cordially recommend it even to that dignified and austere Body which dictates the art taste of the kingdom.

The Chemical Manufacturer's Plant, as Supplied by the St. Helen's Foundry, Lancashire."

This is an illustrated catalogue of various vessels employed in some of the chemical manufactures, notably in the two greater industries, sulphuric acid and soda. Thus we have pyrites' burner frames, nitre pots, decomposing pans, black ash vats, crystallising pans, &c. Some of the decomposing pans described have a thickness of no less than 7 inches at the bottom; the charge of salt is from 5 to 18 cwts.; and the amount of salt-cake decomposed in a pot varies from 1000 to 2700 tons. The "black ash revolving furnace" is also figured, and appears to be replacing the old hand-furnace in Lancashire and elsewhere.

CORRESPONDENCE.

INK.

To the Editor of the Chemical News.

Sir,—In the Chemical News (vol. xx., p. 155) you give M. Voigt's recipe for "a very black and very cheap ink." The objections to it seem to me to be these—(1) It involves a number of unnecessarily troublesome processes; (2) it requires the use of sulphate of copper, which leads to the deposit of copper on steel pens, and so makes them useless; (3) it prescribes corrosive sublimate, which is not good for little boys, who will suck their pens; (4) it recommends logwood, which gives a brownish tone to ink.

For any one who wishes to make his own writing-ink, I do not know an easier or better method than that adopted by the late Professor Daniell, of King's College. He put into a stone-ware jar 1 gallon of soft water, ½ lb. of bruised nut-galls, and next day 6 ozs. of green vitriol, 6 ozs. of gum arabic, and 4 or 5 drops of kreosote. The bottle was then corked, and left in a corner of the room for two or three weeks, so that, once in two days, or so, it might remind the owner that it wanted a good shaking. After this, it was left a few days, and then the clear liquor was decanted off for use. This formed a very black, a very cheap, and, what is more, a very durable ink.

I have letters from Professor Daniell written with such ink a quarter of a century ago, and from Snow Harris (who used the same ink), of the same date, and they form a good written character of this useful black servant.—I am, &c.,

O. T.

September 25th, 1869.

MISCELLANEOUS.

Discovery of Bismuth Ore.—On an estate belonging to M. Carnac, near Balhannah, South Australia, a very valuable lode of bismuth has been found, while some miners were seeking for copper ore. Since bismuth has very much increased in price, and is increasingly in demand, this discovery is a highly welcome one.

Incrustations in Boilers may be prevented by introducing raw potatoes, which cause all solid matters to be precipitated at the bottom of the boiler in a fine powder, leaving the sides perfectly free. The experiment was tried with an engine of 8-horse power, into the boiler of which ten kilogrammes of potatoes per week were introduced through the safety-valve. Every week, when the fires were extinguished, the deposit was removed previous to the introduction of a fresh supply of potatoes. On examining the boiler after fourteen consecutive months of work, no traces of incrustation were perceptible; the appearance of the plates was blackish and slightly greasy, and the corners of the joints were in the same state as when first made. Refuse leather-cuttings from the tanneries will answer the purpose equally well.—*Annales de Génie Civil.*

Electro-Plating of Paper or other Fibrous Material.—The *Druggist's Circular* says—"A mode has been devised for depositing copper, silver, or gold, by the electric process, upon paper, or any other fibrous material. This is accomplished by first rendering the paper a good conductor of electricity without coating it with any material which will peel off. One of the best methods is to take a solution of nitrate of silver, pour in liquid ammonia till the precipitate formed at first is entirely dissolved again; then place the paper, silk, or muslin for one or two hours in this solution. After taking it out and drying well, it is exposed to a current of hydrogen gas, by which operation the silver is reduced to a metallic state, and the material becomes so good a conductor of electricity that it may be electro-plated with copper, silver, or gold, in the usual manner. Material prepared in this manner may be employed for various useful and ornamental purposes.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of every chemical paper in the world, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* Chemical News, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, September 13, 1869.

This number, an unusually small one, contains, among its most remarkable communications, the startling intelligence that the manuscripts and signatures, about which M. Chasles has made so much fuss, are nothing but the work of a clever forger, who, by dint of study and perseverance, has been enabled to carry on a very successful, but, happily, now interrupted, business. M. Dumas read a small portion of a lengthy memoir on the—

Spectrum of the Solar Spots, as observed by the Rev. Father Secchi, S.J.—This paper, and the following, on the—

Constitution of the Luminous Spectra (M. Lecoq de Boisbaudran) are too lengthy, on the one hand, and too concisely written, on the other, to admit of any useful abstraction.

Researches on the Nature of the Products of Fermentation of Glycerine produced by Microzymas.—M. Béchamp.—The author briefly reviews the labours of M. Redtenbacher on this subject, stating that that chemist had transformed glycerine, after addition of beer yeast, into propionic acid. The author of this paper has applied to his researches a mixture consisting of pure glycerine, 250 grms.; chalk, from Sens, full of well and lively-moving microzymas; hashed mutton, quite fresh, and previously washed with cold water, 30 grms.; cold water, 3000 c.c. This mixture has been kept at a temperature of from 35° to 40° for several months. The chief results obtained by the author are, that propionic, butyric, caproic, and valeric acids are formed most abundantly; among the gaseous products, carbonic acid, hydrogen, and nitrogen are found as result of this fermentation.

September 20, 1869.

This number contains the following original papers relating to chemistry or sciences allied thereto:—

Preparation of Nitrogen.—Mr. Calvert.—The author suggests that a mixture of hypochlorite of lime and sulphate of ammonia be made in the following manner:—200 c.c. of an aqueous solution of hypochlorite of lime, containing 5·14 of hypochlorous acid, to which is added 1·146 of sulphate of ammonia, previously dried at 220°; nitrogen gas is immediately given off, even without the application of heat, but it is better to apply heat very gently. The author observes, further, that all nitrogenised animal matters (such as albumen, fibrin, gelatine, silk, feathers, and skin) yield, when mixed with a solution of hypochlorite of lime, especially when heat is applied, a large quantity of nitrogen and carbonic acid. Ulterior researches on this subject are promised.

Researches on the Microzymas of the Blood and on the Nature of Fibrin.—MM. Béchamp and Ester.—This is, strictly speaking, a physiological paper. It is somewhat curious to learn that the coagulation of blood should be due to the juxtaposition and agglutination of minute globules (not the blood corpuscles) and that these globules should be microzymas, and capable of effecting the saccharification of the starch.

Heat Emitted from the Moon.—M. Marié-Davy.—According to the very accurate researches and experimental observations of this author, the heating power of the rays of the moon is incapable of raising the one-millionth part of a degree the temperature of a very sensitive air-thermometer covered with lampblack. This result disagrees with the results obtained by Lord Rosse, when he made observations on this subject.

New Kind of Gunpowder.—M. Brugère.—The author mixes 54 parts of picrate of ammonia and 46 parts of nitrate of potassa; on burning off, this mixture only leaves carbonate of potassa. The following formula explains the reaction:—

$$C_{12}H_3(NO_4)_3NH_4O_2+2(KO,NO_5)=10CO_2+6N+6H+2(KO,CO_2).$$

The author states that this powder presents the following advantages over ordinary powder:—It is more homogeneous, and its effects are consequently more regular; it is far less hygroscopic; it is more effective for equal weights; and it leaves far less solid matter on combustion. The residue left after combustion does not affect metals, since it is only carbonate of potassa; this powder hardly emits any smoke at all, and what little is emitted is devoid of smell. The author recommends a mixture of 25 grms. of picrate of ammonia, 67 grms. of nitrate of baryta, and 8 grms. of sulphur, as an excellent substitute for Bengal light, and as suitable for signal and port lights, and use in theatres, since hardly any smoke is emitted and no unpleasant smell given off, while the light is very brilliant, slow burning, and yields a beautiful greenish tinge.

Annalen der Chemie und Pharmacie, July, 1869.

This number contains the following original papers:—

New Mode of the Formation of Nitro-Prussides. — M. Stüdeler.—The author begins this monograph by a lengthy description of the manner in which he ascertained the composition of the orange-coloured precipitate which ensues when a solution of cyanide of potassium is added to a solution of a proto-salt of iron. The quantitative estimation of the proportions of the proto-salt of iron and of the cyanide of potassium were found to be in relation as 3 : 4, or 4 : 5; the formula for the orange-coloured precipitate alluded to is, accordingly, Fe_3Cy_5K. In order to test the accuracy of this formula, the author tried to convert the orange-coloured precipitate into a nitro-prusside, according to this schematic formula—

$$Fe_3Cy_5K+NO.OK=FeO+Fe(NO)Cy_5K_2.$$

The result of experiment confirmed the correctness of the author's opinion; but the reaction was not found to take place so simply, for, instead of the formation of protoxide of iron and nitro-prusside of potassium, there is formed magnetic oxide of iron and the nitro-prusside; the formation of the nitro-prussides without acids is, therefore, the author's discovery. The orange-coloured precipitate above alluded to is converted into nitro-prusside by being treated with nitrite of potassium, best, after that orange-coloured body has become oxidised, by exposure to air. A portion of this paper is devoted to the discussion of the correctness of the formula generally adopted for nitro-prussides, and due to Gerhardt's researches on this subject.

On Anisaldehyde.—Dr. Rossel.—The author first reviews the labours of MM. Cahours, Piria, Canizzarro, Bertagnini, and others, on this subject. The author states that the anisaldehyde is best prepared by mixing 1 part of essential oil of anise, 2 parts of bichromate of potassa, 3 parts o iconcentrated sulphuric acid, and 8½ parts of water. When 100 grms. of the essential oil are operated upon, about 50 per cent of aldehyde is obtained. The raw product, after having been purified, exhibits a nearly colourless fluid, of 1·1228 sp. gr. at 18°; it is readily soluble in alcohol and ether, but not so in water; its reaction is neutral, but, since it oxidises very readily to anisic acid, a few drops of the aldehyde, on exposure to air, become solid, and, at the same time, exhibit acid reaction to test-paper. This aldehyde is composed of $C_8H_8O_2$. The author has succeeded in obtaining several derivatives from this anisaldehyde, among which are anisoine, $C_{56}H_{16}O_4$, a solid substance crystallising in six-sided prisms, hydranisoine, isohydranisoine, desoxyanisoine, and anishumine.

On Diphenyl.—M. Brönner.—While engaged in rectifying a large quantity of benzol, made by the distillation of a mixture of benzoate of lime and slaked lime, there remained in the retort a solid crystalline substance, which was found to be insoluble in water, and readily soluble in ether and in boiling alcohol, from which latter solution it was obtained in a pearly, crystalline mass, fusing at 70·5°, and which, on being submitted to elementary organic analysis, yielded results leading to the formula, $C_{12}H_{10}$—that is to say, the same as the substance M. Fittig obtained by acting with sodium upon monobrombenzol. The reactions of the latter substance, as described by Fittig, and tried by the author of this paper, with the substance obtained by him in the manner above described, agree in all respects; and there is no doubt, therefore, that both materials are identical, and deserve to bear the same name.

Relations existing between Amylen and Oil of Turpentine.—Drs. Bauer and Verson.—The chief leading points of this memoir may be summarised thus:—1st. Two molecules of amylen form one molecule of diamylen—

$$C_5H_{10}+C_5H_{10}=C_{10}H_{20}.$$

2nd. Diamylen and bromine form diamylen-bromide; and this last named substance forms rutylen, when it is treated with an alcoholic solution of caustic potassa—

$$C_{10}H_{20}Br+2KHO=2KBr+2H_2O+C_{10}H_{18}.$$

3rd. Rutylen forms, with bromine, a bromide of rutylen, and this, on being treated with an alcoholic solution of caustic potassa, yields the new hydrocarbon—

$$C_{10}H_{18}Br+2KHO=2KBr+2H_2O+C_{10}H_{16}.$$

$C_{10}H_{16}$ is evidently related to tereben, which, as observed by M. Berthelot, is the "terme commun et stable auquel tous les carbures, $C_{10}H_{10}$, viennent aboutir."

Products of the Action of Chlorous Acid upon Naphthaline.—M. Hermann.—The products obtained by this reaction are—An acid containing chlorine, phthalic acid, the acid potassa salt of a new sulpho-acid, and bichloride of naphthalin. The author describes these products, and many of their combinations, at great length. The formula of the chlorine containing acid is $C_{10}H_7ClO_5$; this acid readily forms salts, most of which crystallise. The bichloride of naphthaline, $C_{10}H_8Cl_2$, is a solid crystalline substance, fusing at 68°, and soluble in alcohol. The new sulpho-acid above named is *Naphthochinonsulpho acid*, the potassa salt of which contains, in 100 parts:—Carbon, 36·73; hydrogen, 1·22; potassium, 12·00; chlorine, 10·87; sulphur, 9·79; oxygen, 29·39. Formula, $C_{10}H_4KClSO_6$.

Specific Heat of Saturated Vapours.—M. J. A. Groshans.—This paper, a very learned essay on this subject, being entirely based upon higher algebra, is not well suited for abstraction.

Some Derivatives from Creosol.—M. Biechele.—The author first reviews the labours of Hlasiwetz, Hugo Müller, Gorup-Besanez, Sobrero, and others, on this subject; and then he describes a series of his own experiments, treating first on creosol-potassium—

$$C_8H_9KO_2+2H_2O.$$

Creosol, obtained by decomposing the salt just named by means of sulphuric acid. The substance thus obtained is, after purifying, a colourless, oily liquid, highly refractive, boiling between 209° and 220°, becoming a solid mass when treated with ammonia, and reducing salts of silver to the metallic state; formula, $C_8H_{10}O_2$. Creosol-sulpho acid.—The result of the action of sulphuric acid upon rectified creosote is a liquid readily absorbing water from the atmosphere; its formula is $C_8H_9O_2.SO_3H$. This acid forms, with baryta, oxide of lead, and potassa, salts readily soluble in water. When chloride of phosphorus acts upon creosote, the chloride of creosol, C_8H_9OCl, is among the products.

Action of Hypochlorous Acid upon Butylen.—M. Lieben.—By this reaction, butylen-chlorhydrin, chlorinated dibutylen-chloride, are obtained; but the very concise description given by the author, of a long series of rather complicated chemical operations, cannot be readily condensed. The formula of chlorinated dibutylen-chloride is—

$$\left\{\begin{matrix}C_4H_8Cl\\C_4H_7Cl.Cl.\end{matrix}\right.$$

Since the oxidation of an alcohol obtained from butylen-chlorhydrin yields acetic acid, the author states as his opinion, based upon his researches, that the alcohol just alluded to is ethyl-methyl-carbinol.

The two remaining papers in this number are taken, one from the *Proceedings of the Royal Society*, the other from the *Comptes Rendus*, and have both been already abstracted in our pages.

August, 1869.

This number contains the following original papers:—

Amines of Xylyl-Alcohol.—Dr. O. Pieper.—Chlorine gas is first passed into boiling xylol, and the chloride so formed is treated at 116°, in sealed tubes, with a strong solution of ammoniacal gas in alcohol. The contents of the tube, after the reaction was finished, was treated with alcohol; and this fluid, along with excess of ammonia, was removed by distillation. The author thus obtained trixylylamine, $(C_8H_9)3N$, a colourless, viscous, oily fluid, specifically lighter than water, not soluble in that fluid, difficultly soluble in alcohol, but readily soluble in ether. Hydrochlorate of trixylylamine, $(C_8H_9)_3N,HCl$, a solid substance, exhibiting perfectly snow-white needle-shaped crystals, not soluble in water and ether, difficultly soluble in cold, but readily in hot alcohol, and fusing at 212°. Bixylylamine, $(C_8H_9)2HN$, a somewhat yellowish coloured oil, exhibiting an alkaline reaction to test paper, specifically lighter than water, insoluble therein, soluble in alcohol and ether, and decomposed if heated above 210°. Xylylamine, $(C_8H_9)H_2N$, also an oily liquid, boiling at 196°, soluble in alcohol and ether, and insoluble in water; it attracts carbonic acid from the air, and solidifies.

Decomposition of Tri- and Bi-Benzylamine by Heat.—Dr. L. Brunner.—The author divides his essay in two parts, treating in the first on the products of distillation of tri- and bi-benzylamine. Among the fluid products is toluol, boiling at 112°. Among the solid

products, dibenzyl, $C_{14}H_{14}$, obtained, after re-crystallisation, in large foliated shiny crystals fusing at 52°; toluylen, $C_{14}H_{12}$, a solid body, fusing at 120°. Among the residues of the distillation, left in the retort, and treated of in the second part of this essay, we notice lophin, $C_{21}H_{16}N_2$, a solid body, crystallising in needle-shaped crystals, fusing between 260° and 270°. When lophin is placed in a current of dry hydrochloric acid gas, and a dry current of carbonic acid gas passed over it, the compound $C_{21}H_{16}N_2HCl$ is formed.

Amines of Chlorinated Benzyl-Alcohol.—M. Berlin.—By a complicated process, described at too great length for any useful abstraction, the author has obtained a series of chlorinated compounds, and combinations of these with other substances. We notice among them—Chlorinated tri-benzylamine, $(C_7H_6Cl)_3N$, a solid substance, soluble in alcohol, and fusing at about 89°. Chlorinated bi-benzylamine, $(C_7H_6Cl)_2HN$; the author discovered no less than four varieties of this base, designated, respectively, α, β, γ, and δ, and studied the salts they form. Chlorinated benzylamine, $(C_7H_6Cl)H_2N$, a colourless liquid, readily soluble in alcohol and ether, but not in water; it attracts carbonic acid from the air, and is thereby converted into a solid substance.

Variable Behaviour of Iodine towards Hydrosulphuric Acid under Divers Conditions, and the Causes thereof.—M. A. Naumann.—This essay treats on the part water (and what the author calls thermochemical action) plays in the reactions between iodine and sulphuretted hydrogen gas. Dry sulphuretted hydrogen and iodine, dissolved in anhydrous sulphide of carbon, do not act at all upon each other; neither does sulphuretted hydrogen act upon solid iodine, or vapours thereof if water is excluded. The greater portion of this essay is not well suited for abstraction.

Researches on Phloron and Cresol, and some of their Derivatives.—A. von Rad.—This is a lengthy monograph on the subject named; the mode of treatment and the concise manner in which it is written make it unsuitable for condensation.

Conversion of Urea into Carbaminic Acid.—M. H. Bunte.—About 8 grms. of nitrate of urea were mixed with absolute alcohol, and heated in a sealed tube, for some hours, at about 130°. The contents of the tube, which had nearly become solid, were dissolved in water, next treated with ether, and, after more purifying, a substance was obtained yielding, on elementary analysis, results leading to the formula $C_8H_7NO_8$. The remainder of this paper is devoted to a lengthy theoretical discussion on the various methods to ascertain the true nature of *substituted* ureas.

Condensed Ureas.—M. Schiff.—The author describes, at great length, a number of compounds which he calls *condensed ureas*, and which are made up according to the general formula—

$$XCH_4N_2O+(X-1)CnHmO-(X-1)H_2O.$$

Since this paper is, *de facto*, an exhaustive monograph on this subject, it is difficult to give any further abstract of the details it contains.

Compounds of Ammonia and Sulphate of Zinc.—M. G. Müller.—The author gives the following results of analysis of compounds of sulphate of zinc and ammonia, percentically:—Oxide of zinc, 30·58; sulphuric acid, 30·18; ammonia, 25·65; water, 13·59. Formula—

$$1ZnO1SO_34NH_62H_2O.$$

Oxide of zinc, 26·91; sulphuric acid, 26·58; ammonia, 22·59; water, 23·92. Formula—

$$1ZnO1SO_34NH_34H_2O, \text{ or } \left(\begin{matrix}SO_2\\Zn\end{matrix}\right\} O_24NH_3\Big)_4H_2O.$$

Recovery of Nitrate of Uranium from the Phosphate of Uranium, and on a Nitro-Phosphate of Oxide of Uranium.—M. Heintz.—Since this paper bears upon a subject of importance to many chemists, and, since it is too lengthy for suitable abstraction, we intend to give it in full at a future period.

Chromate of Oxide of Zinc and Ammonia.—M. L. Bieler.—The author describes, at great length, the preparation of a salt composed, in 100 parts, of—Oxide of chromium, 33·01; oxide of zinc, 26·73; ammonia, 22·44; water, 17·82. This salt is readily soluble in dilute acids, crystallises, is decomposed by water, exhales ammonia constantly, and is, hence, readily and spontaneously decomposed.

Behaviour of Boracic Acid towards Oxide of Copper, Borate of Copper, and Ammonia.—M. Pasternack.—After reviewing the labours on this subject by MM. Tiinnermann and Rose, the author records some experiments made by him in order to settle what compound is formed when a solution of two parts of sulphate of copper, and a solution of one part, by weight, of borax, are mixed, care being taken to pour the latter solution into the former. The mixture was next heated, filtered, and washed with warm water, whereby all the boracic acid was eliminated, and a salt left containing, in 100 parts—Sulphuric acid, 18·65; oxide of copper, 64·65; water, 16·79. To the filtrate obtained was added a fresh quantity of solution of borax, and a salt obtained containing, percentically—CuO, 52·72; B_2O_3, 18·59; H_2O, 28·69. A combination of boracic acid, ammonia, oxide of copper, and water, a true basic salt, had the following percentical composition:—CuO, 20·80; B_2O_3, 35·41; NH_3, 17·20; H_2O, 27·31.

Borate of Zinc and Ammonia.—M. Büscher.—This paper is analogous to the foregoing. The borate obtained consists, in 100 parts, of—ZnO, 20·40; B_2O_3, 35·27; NH_3, 17·13; water, 27·20.

Action of Acids upon Carbylamines.—This paper is not well suited for useful abstraction.

Synthesis of Paramonochlorobenzoic Acid.—M. C. Muller.—The acid just named is obtained in large quantity by the oxidation of chloride of benzol, after having been purified and dried over sulphuric acid. Paramonochlorobenzoic acid is a solid, fusing at 235°, readily soluble in alcohol and ether, but very difficultly soluble in water. Formula, $C_7H_5ClO_2$. Its baryta salt crystallises readily.

New Mode of Formation of Ethylsulphuric Acid.—M. Heusser.—By means of the action of sesquichloride of sulphur upon alcohol, and simultaneous exclusion of oxygen, the author has succeeded, by a method described at great length, in obtaining a baryta compound, $(C_2H_5)Ba''S_2O_8(OH_2)_2$, which is ethyl-sulphate of barium. The paper discusses, at great length, the labours of MM. Carius, Warlitz, and others on this subject.

Nitride of Boron.—M. Darmstadt.—The author finds that this compound of boron and nitrogen can be readily obtained when one part of previously fused and powdered boracic acid, and about two parts of urea, are mixed and heated in a covered porcelain crucible, first more gently, at last to red heat. The fused mass is lixiviated with hot water acidified with a few drops of hydrochloric acid, in order to promote the deposition of the nitride of boron.

Journal de Pharmacie et de Chimie, August, 1869.

This number contains the following original papers:—

Magnetic Oxide of Iron and its Salts.—M. Lefort.—After briefly referring to the labours of M. Fourcroy, and other chemists of comparatively older date, the author describes, at some length, the preparation of the ferroso-ferric oxide of iron in the following manner:—100 grms. of pure sulphate of protoxide of iron is dissolved in a small quantity of distilled water previously freed, by long-continued boiling, from all air; 200 grms. of the same salt are placed in a suitable vessel, containing already 50 grms. of nitric acid and 50 grms. of water. This mixture is heated on a sand-bath, until the whole of the sulphate of iron is peroxidised, and a dark brownish red liquor is obtained, which, after having become quite cold, is added to the solution of 100 grms. of sulphate of iron. The author next proceeds to make a boiling concentrated solution of either caustic potassa or soda, and, while this is kept boiling, the mixed solution of iron salts is cautiously added, drop by drop, to the alkaline liquid. In this manner a very beautiful magnetic oxide of iron is obtained, which, on account of its great density, is easily washed with previously well boiled, and still hot, distilled water. After washing, it should be carefully dried over sulphuric acid. After having been thus well dried, the author found, on analysing it, that its composition corresponds to the formula $FeO+Fe_2O_3+HO$. When dried by means of heat, gradually applied, the water is eliminated, and oxidation at the same time sets in; and when the substance is entirely dry, it is, also, entirely converted into Fe_2O_3. The quantity of water contained in the air dried (over sulphuric acid) magnetic oxide, amounts to 7·20 per cent. The composition of the chloride of this magnetic oxide, a perfectly well-defined salt, is, in 100 parts:—Chlorine, 36·57; iron, 21·66; water, 41·77. Formula, $4Cl3Fe18HO$; or—

$$4Cl\left\{\begin{matrix}Fe\\Fe_2\end{matrix}\right\}+18HO.$$

The author has also succeeded in obtaining a sulphate; but the stability of these salts is, after all, very slight.

Synthesis of Phenol.—M. Berthelot.—The author has combined acetylen with fuming sulphuric acid, thereby forming acetylenosulphuric acid, which is not decomposed even by boiling water. The author has next prepared acetylenosulphate of potassa; and, on decomposing this salt, phenol was obtained in large quantity. Acetylenosulphuric acid should not be confused with acetylsulphuric acid, which is a totally different body, and readily decomposed, even by cold water.

Utility of Common Salt as Applied to Agriculture.—M. Peligot.—This lengthy paper is chiefly written with the view of criticising a paper published some time ago by M. Velter, "On the Utility of Common Salt to Agriculture, in consequence of its Ulterior Transformation into Carbonate, and, lastly, Nitrate of Soda." The chief result of M. Peligot's researches is, that when common salt naturally occurs in an arable soil, some plants assimilate this salt, but the greater number leave it unassimilated.

Milk met with in Algeria.—M. Commaille.—This paper contains the results of a series of analyses of milk from cows, goats, and sheep, taken at different periods after the birth of the young of these animals, while care is taken to ascertain the various races these different beasts belong to. Goat's milk, general average—Butter, 45·25; caseine, 35·34; lactine, 49·32; lactalbumine, 8·27; lacto-proteine, 1·90; ash, 7·77. Sheep's milk—Butter, 53·75; caseine, 41·85; lactine, 44·94; lactalbumine, 11·30; lacto-proteine, 3·16; organic acids, 4·63; ash, 9·22. The chief result the author points out is, that the milk in Algeria is better, that is to say, richer, especially in nitrogenised compounds, than the milk met with in Normandy and the Elsass.

On a Milk Mushroom (Champignon).—M. Hesling.—The author points out that, even long before milk becomes sour, there are generated in it very small organised spores of an *ascophora* species.

Annalen der Physik und Chemie, von Poggendorff, No. 8, 1869.

This number contains the following original papers and memoirs:—

Researches on the Impact of a Jet of Water.—Dr. Buff.—This is a very lengthy physico-mechanical essay, not bearing in any way upon chemical science. The makers of fire engines will find much interesting matter in this paper.

Limits of Magnetisation of Iron and Steel.—Dr. von Waltenhofen.—A monograph on this subject, the contents of which are entirely of a mathematico-physical nature.

Some Double (Tisin) Crystals of Sulphuret of Iron (Iron Pyrites).—Dr. Hessel.—This is a purely crystallographical essay on this subject, illustrated by a series of engravings.

Regular Cavities which Naturally Occur, or may be Artificially Produced on the Planes of the Crystals of Quartz.—Dr. J. Hirschwald.—Also a purely crystallographical essay, illustrated by several engravings.

Researches made for the Purpose of Determining the Electromotoric Force between Water and some Metals, by means of the Galvanic Compensation.—Dr. E. Gerland.—A mathematico-physical essay.

Meaning of Insulators in the Theory of Electricity.—M. Schwedoff.—This is the continuation of a lengthy monograph on this subject commenced two volumes previously; it is entirely a mathematico-physical essay.

Transversal Magnetismus of Iron and Steel.—Dr. E. Villari.—A very lengthy monograph, very concisely written, and purely mathematico-physical in its contents.

Researches on the Behaviour of Vapours towards the Law of Marriotte.—Dr. Herwig.—The second part of an extensive monograph on this subject, too lengthy and too abstrusely written to be fit for abstraction.

Meteorite of Krähenberg, near Zweibrücken.—M. E. Weiss.—This paper does not contain anything new on this subject, of which we gave an abstract of a paper taken from a previous number of this periodical (CHEMICAL NEWS, vol. xx., p. 83).

Observations of Solar Protuberances.—M. Zöllner.—We regret that we cannot extract this paper, as it is copiously illustrated with ten very beautifully executed coloured engravings, which are absolutely required for the proper understanding of the subject.

Evolution of Heat Caused by the Emission of Sound from Solid Bodies.—M. E. Warburg.—A purely physical essay.

American Journal of Pharmacy, September, 1869.

We learn from this number of the death of Prof. H. E. Dussauce, which took place at New Lebanon, Columbia County, N.Y., on the 20th of June last. The deceased, who was born on the 25th of December, 1829, at Paris, was a pupil of Chevreul, and was for a time one of the Professors of Industrial Chemistry in the Ecole Polytechnique. The deceased occupied the position of chemist in Tilden and Co.'s Laboratory, and was one of the editors of the *Journal of Applied Chemistry*, and the editor of several other works. The deceased was well known in Europe as an eminent technologist and an excellent analyst.

This number contains the following original papers and communications on subjects of scientific interest for chemists. We omit some papers relating to the practice of pharmacy, of which it should be said, however, that they highly deserve the attention of those concerned:—

Critical Note on Permanganate of Potassa as a Test for Distinguishing Chlorine, Bromine, and Iodine.—Mr. G. Macdonald.—The author has investigated this subject carefully, and made a series of experiments, the main results of which are, that this method of distinguishing, by means of the reaction produced by permanganate of potassa, between the three haloids above named, is only applicable to very dilute solutions, and, even then, care must be taken that the permanganate of potassa is also in very dilute solution, and added drop by drop, as any excess beyond what the iodide or bromide would decompose would be apt to give the liquid its own characteristic tint. Moreover, the method is applicable to simple solutions of haloid salts, and its use implies some previous knowledge by the operator, both of the composition and the strength of the solution under examination. In a compound solution of a chloride and iodide, this test, *per se*, would be of but little use, as only the presence of the iodide would be indicated, and recourse to other methods would be necessary for the detection of the chloride. In a solution containing no haloid whatever, as, for example, a solution of a nitrate or a sulphate, this test would indicate the presence of a chloride—that is, no change would be produced on the addition of the permanganate. In a solution containing organic matter, the test would, in many instances, be rendered worthless, since the permanganate is readily decomposed by such substances, with changes very similar to those produced by the action of iodides or bromides.

Sulphur in Louisana.—The Louisana Petroleum Company, while boring for oil near Lake Charles, reached, at a depth of 442 ft., strata of crystallised sulphur, some 2 ft. thick, and of very pure quality. On boring farther downwards, the augur passed, for a distance of 90 ft., through limestone rock, which yielded about 50 per cent of sulphur, with occasional strata of 6 to 8 feet in thickness of pure sulphur. The boring has now reached to a depth of 600 ft. The Company intend to begin mining operations for the extraction of sulphur, but the cost of such work cannot fail to be very large; yet it appears that there is so great a demand for sulphur in the States that mining it at this depth will pay.

Zeitschrift für Analytische Chemie, von Dr. C. R. Fresenius, second number for 1869.

This number contains the following original memoirs and papers:—

Preservation (Storing) of Solutions of Protochloride of Tin, Sulphuretted Hydrogen, and the like.—Dr. F. Mohr.—The keeping of large quantities of titrated solutions is what is meant by the author, who advises that such solutions, after having been made in large quantity, should be poured in bottles provided with a tubulure at the bottom, through which a perforated cork, into which a downward-bent glass tube is fitted, and that this tube should be connected with another longer tube, by means of india-rubber fittings, and so arranged as to admit of running fluid into a burette; the neck of the bottle is fitted with a perforated cork, wherein a narrow glass tube is inserted. In order to prevent the action of the air upon the fluid contained in the bottle, a layer of petroleum, 1 centimetre high, is poured on the fluid. Saturated aqueous solution of sulphuretted hydrogen may be preserved in the same manner; but the bottle containing it should be kept in a cool place, and not exposed to direct sunlight.

Analysis of Ferromanganese.—M. Darmstadt.—Ferromanganese is a peculiar variety of iron which contains a large quantity of manganese. The general plan of analysis followed in this instance by the author is the same as that published in Fresenius's last edition of "Qualitative Analysis"; the estimation of the carbon was made by Berzelius's method, dissolving the iron in neutral chloride of copper. The result of the analysis quoted, percentically, is:—Iron, 73·474; manganese, 21·064; cobalt, 0·007; zinc, 0·062; copper, 0·072; lead, 0·011; aluminium, a trace; titanium, 0·011; calcium, 0·175; magnesium, 0·035; arsenicum, 0·001; antimony and tin, 0·030; phosphorus, 0·109; sulphur, a trace; silicium, 0·059; carbon, 4·805.

Separation of Oxide of Uranium from Phosphoric Acid.—M. Reichardt.—The author refers to the separation of phosphoric acid from oxide of uranium where the latter is used in large quantity for the estimation of phosphoric acid. Dissolve the phosphate of uranium in hydrochloric or nitric acids, apply heat, add excess of chloride of iron, and, next, excess of solution of carbonate of soda; wherein, aided especially by the large quantity of carbonic acid which is thus set free, the oxide of uranium is readily dissolved, while the phosphoric acid is combined with the oxide of iron. The solution of oxide of uranium in carbonate of soda is acidified with hydrochloric acid, boiled to expel carbonic acid, and the oxide of uranium next precipitated with ammonia.

Estimation of Organic Matter and Nitric Acid in Well Waters.—M. Reichardt.—This paper is chiefly a review, criticising the value and reliability of a number of methods for the quantitative estimation of organic matter and nitric acid in potable water. From this paper we incidentally learn that the water of the well of the house, No. 42, Gerichtstrasse, Berlin, contains, in 1 litre, 0·675 grm. NO_5. The average of twenty-seven different samples of well-water of Liepzig is 0·346 grm. to the litre. The water of the waterworks of Liepzig contains 11·5 parts of NO_5 in 1,000,000 parts of water.

Modification of the Piknometer.—Dr. Gintl.—Since, without the woodcuts annexed to this paper, its contents could not be clearly understood, we only quote the title.

Estimation of Phosphoric Acid in the shape of Pyrophosphate of Magnesia.—Dr. Kubell.—This paper is a concisely written treatise, divided into two sections—the first of which treats of the solubility of the ammoniacal phosphate of magnesia in water containing ammonia; the other section treats of the precipitate caused, in an ammoniacal solution containing phosphoric acid, by excess of solution of magnesia. This treatise does not admit of suitable and useful condensation.

Changes Albuminates Suffer when they are Submitted to the Action of Water.—Dr. W. Schmidt.—Albumen, prepared from serum of blood, casein, fibrin, and other similar materials, were submitted, in sealed tubes, to the joint action of a high temperature, ranging from 135° to 150°, and water, in order to test the correctness of M. Meissner's statement that these materials yield, when so treated, peptones. This, however, is not the result of the author's researches, which have not brought to light any other results than those generally known on this subject.

Improvement of the Volumetrical Estimation of Copper and Zinc contained in Ores by means of a Standard Solution of Ferrocyanide of Potassium.—M. Galetti.—This paper is reserved for full translation.

Description of an Improved Apparatus for the Evolution of Sulphuretted Hydrogen.—Dr. Seelhorst.—Without the engravings annexed to this paper, it cannot be well understood.

Peculiar Appearance Shown by the Flame of Burning Hydrogen.—Dr. Seelhorst.—The author has repeated Barett's well-known experiments of holding in the flame of burning hydrogen gas very well cleaned glass rods, metals recently cleaned by filing them just previous to the holding in the flame, and has observed the same blue colouration as M. Barett did. But the author is not at all inclined to ascribe this colouration to the effect of burning sulphur, which should be so generally spread about in the shape of some sulphate, as to produce this colouration. The author, though abstaining from stating any precise cause at all, inclines to the belief that the cooling effect of the cold body held in the flame has something to do with this phenomenon. Perfectly pure hydrogen, burning from a platinum burner, as well as from iron or glass burners, exhibited the phenomenon, when cold bodies, just after having been cleaned by scraping or filing, were held in that flame. These experiments were conducted in a laboratory, repeated in a lecture-hall, and in the taproom of a *café* with the same result.

Estimation of Lime and its Separation from Magnesia when Dolomites are to be Analysed.—Dr. A. Cossa.—The author's object has been to determine what the accuracy is of estimating lime as quicklime or caustic lime, instead of weighing it as carbonate of lime. The experiments were made—(1) With pure oxalate of lime previously dried at 100°; (2) with carbonate of lime precipitated from a solution of pure chloride of calcium by means of pure

carbonate of soda; (3) with pure, native carbonate of lime, Iceland spar. The result of an average of three experiments with No. 1 is 0·07 per cent too low; with No. 2, 0·35 per cent too low; with No. 3, 0·27 per cent too high. As regards the analysis of dolomite, the author states that, when care is not taken to re-dissolve the precipitate of oxalate of lime first obtained and re-precipitate this a second time, it is always so contaminated with oxalate of magnesia or ammonio-oxalate of magnesia that the quantity of lime found as carbonate may be 0·62 per cent in excess of what it ought to be, while the loss for carbonate of magnesia may even be as high as 0·78 per cent.

Analysis of Soft Lead.—Dr. Fresenius.—This paper or treatise is an exhaustive monograph on the analysis of refined lead and the estimation therein by volumetrical methods of iron, copper, zinc, antimony, and other metals. This treatise, as might be expected from the eminent author, is as complete as can be desired, but it is too lengthy and too concisely written for useful abstraction.

Comparative Researches on the Estimation of Phosphoric Acid.—M. Kissel.—The author treats on the gravimetrical and volumetrical methods in use for the estimation of this acid. (*a*) Direct estimation as pyrophosphate of magnesia; average result of three carefully conducted experiments, 99·53 per cent; result by the same method, but with the correction required for the solubility of the ammonio-phosphate of magnesia in ammoniacal water, average of three experiments, 100·22 per cent. (*b*) Indirect estimation as pyrophosphate, following a previous precipitation as molybdo-phosphate of ammonia; average result, without correction for solubility of ammonio-phosphate of magnesia, 99·09 per cent, with that correction, 99·79 per cent; estimation (gravimetrical) as phosphate of oxide of uranium; average result, 100·33 per cent; estimation as basic phosphate of iron; average result, 99·68. Volumetrical methods: Average result of four experiments with acetate of oxide of uranium, 100·12 per cent. The author has purposely made a series of experiments in order to ascertain the influence of repeated solution and re-precipitation of the ammonio-phosphate of magnesia, obtained in quantitative research, also the influence of excess of ammoniacal salts and the action of dilute ammonia upon pure ammonio-phosphate of magnesia, the results obtained do not materially differ from what is generally known on this subject and published thereon in works on analytical chemistry.

Application of the Principle of Areometry to Quantitative Chemical Analysis.—Dr. Gintl.—The plan devised by the author is extremely ingenious, and deserves the attention of analysts; but we cannot condense his paper or make the principle even understood without the reproduction of some engravings absolutely necessary for the explanation of the subject.

Detection of Bitter Substances other than Hops in Beer.—M. L. Enders.—In order to separate lupuline from quassiine, absynthiine and menyanthine, the author proceeds as follows:—Alcohol is applied to separate gum, a mixture of strong alcohol and ether to separate sugar from beer; the solution of bitter substances is next treated with acetate of lead; a precipitate ensues which contains lupulin and hop-resin; treat precipitate with H_2S, separate PbS, wash with alcohol, evaporate the filtrates to dryness, exhaust residue with chloroform, and repeat this operation, adding a large quantity of warm water; evaporate chloroform when the hop-resin is left as an insoluble matter in the water, which, after separation of this resin, is also evaporated to dryness; the residue has a bitter taste; exhibits when dissolved in water an acid reaction to test paper; is soluble in alcohol, ether, and chloroform; the weak alcoholic solution is precipitable by acetate of lead, but not by tannic acid; does not give, when treated with ammoniacal silver-solution, a deposit of metallic silver. These characters indicate lupuline. The filtrate from the solution above alluded to is freed by means of H_2S from excess of lead, the sulphide of that metal removed by filtration, the filter washed with hot water, and the filtrate heated in order to expel sulphuretted hydrogen gas; and next, a solution of tannic acid is added; in case a precipitate ensues, it is collected on a filter, some pure carbonate of lead is added to the precipitate while yet wet, and the mass is dried, next boiled with alcohol, the filtrate therefrom evaporated to dryness and exhausted with pure ether. This ethereal solution is evaporated to dryness, the residue is either soluble in alcohol, or in a large quantity of hot water, the aqueous solution is precipitable by means of tannic acid, not by acetate of lead; the precipitate is first mixed with concentrated sulphuric acid, and, on addition of some water, yields a bluish violet colour. The substance boiled with ammoniacal solution of silver yields a metallic mirror: these characteristics indicate absynthiine. The residue insoluble in ether is soluble in alcohol; this solution, after having been diluted with water, is precipitable by tannic acid, not by acetate of lead; the substance, on being heated with ammoniacal solution of silver yields a metallic mirror, indicating menyanthine; absence of metallic mirror indicates quassiine.

Comptes, September 4, 1869.

Origin of the Alkaline Chlorides found in the Water and Rocks of the Coal-Formation of Luijk, Liège (Belgium).—M. Malherbe.—After referring to the doubts existing about the question whether the plants which have given rise to the coal-fields have been submerged by fresh or salt water, or by a mixture of both, the author contends that, as far as the coal-basin above named is concerned, his opinion is that the plants which served to form the coal, were submerged in a mixture of fresh and salt water, since not only the water pumped up from the pits in the locality mentioned contains a large proportion of alkaline chlorides, but the rocks in that part of the country also contain a considerable quantity of these salts. The author's opinion is not shared by the well-known eminent Belgian geologist, M. Omalius d'Halloy, who states that coal has been formed in a similar manner as peat is at the present day, in stagnant fresh water; but the presence of the alkaline chlorides is accounted for, by later irruptions of the sea, and by the many commotions the coal formations have been subject to long after they were formed.

Revue Hebdomadaire de Chimie, September 2, 1869.

This number contains an excellent description of—

The Freezing Apparatus Invented by M. Toselli.—The author applies freezing mixtures made up without the addition of acids, and chiefly prefers the following salts:—Nitrate of ammonia, carbonate of soda, sal-ammoniac, and chloride of potassium, mixed in certain quantities together. The mixture best adapted for his apparatus is made up of equal parts of nitrate of ammonia, carbonate of soda, and water, wherewith a lowering of temperature of −33° can be obtained. Without the reproduction of the woodcuts annexed to this paper, it would be useless to try to describe the apparatus applied by the author, who conducts, at Paris, a business, on a large scale, for the artificial production of ice, and the sale and making of his apparatus and the salts used for the production of cold. According to all accounts, his invention is the best and most applicable of the kind hitherto made.

Les Mondes, September 9, 1869.

The Deepest Artesian Well in the World.—If the American reporter of this periodical is well informed there exists at Saint Louis, U.S., an artesian well, which, as far back as the year 1854, had been bored to a depth of 2199 feet, without reaching water bearing strata. In 1865, the previously suspended borings were resumed, and are yet pushed forward; but though a depth of 2852 feet has been reached, no water bearing strata has been found. The borings now proceed only about three inches depth every day, in compact solid granite, and the cost per month amounts to 1600 dollars.

NOTES AND QUERIES.

Estimating Ammonia.—In answer to the query of "A. Z." (CHEMICAL NEWS, vol. xx., p. 156) respecting a ready commercial method of estimating the percentage of ammonia in sulphate of ammonium, I beg to say that the readiest and most reliable method for this purpose is as follows:—Place a known weight of the salt in a flask fitted with cork and bent tube with bulb (the bend and the bulb are to prevent spirting and carrying over of any caustic liquor by the steam), and, having dissolved in a small quantity of water, distil, with a strong solution of caustic soda, potash, or milk of lime, into a beaker containing a known volume of a titrated solution of hydrochloric acid. The liquid in the flask is boiled till two-thirds are distilled over into the acid, which must be kept cool by immersing the beaker in a vessel of cold water, and keeping a stream of water circulating through the latter during the experiment. The tube is now carefully withdrawn from the acid, still keeping the lamp under the flask, or the contents of the beaker would immediately be sucked back. Just as the tube emerges from the liquid, it is well rinsed with the wash-bottle. The partially-neutralised solution in the beaker is washed out into a basin, tincture of cochineal added, and then the excess of hydrochloric acid is determined at once, in the cold, by means of a sodic carbonate solution of exactly equivalent strength to the hydrochloric acid. The volume of sodic carbonate solution subtracted from that of the hydrochloric acid equals the volume of acid solution required; and the HCl solution should, for the sake of rapidity of working, be so graduated that the number of volumes required should equal the percentage of NH_3 in the salt. If pyrites has been used in the manufacture of vitriol, the vitriol is contaminated with anhydrous persulphate of iron (as a white deposit, which disappears on dilution), and also with a large quantity of arsenic: if, then, iron and a comparatively large quantity of arsenic be found to exist in a sample of vitriol, I think "A. Z." may take it for granted that pyrites has been used in this case. This method is applicable for the estimation of ammonia in any of its salts, providing that these be free from any organic nitrogenous matter. The caustic solutions (potash, soda, or lime-milk) should be well boiled previous to use, and allowed to get quite cold again: this is to free them from all traces of ammonia. In a subsequent communication, I will give the methods for the calculation and construction of volumetric solutions, from which the percentages may be immediately ascertained as being identical with the number of volumes of such volumetric solutions required.—WATSON SMITH, F.C.S., West Gorton, near Manchester, Sept. 27, 1869.

TO CORRESPONDENTS.

Enquirer.—We do not know if Professor Jellett's paper has been published or not.

A Constant Subscriber.—We know of no book treating on the proximate analysis of bodies only, but it is treated of in Watts's "Dictionary" under the word "analysis."

A. B. C.—(1) A new work on Dyeing is in the press; (2) Reimann's work on Aniline, price 10s. 10d., post free from our office; (3) Apply to Professor Calvert, at the Royal Institution, Manchester; (4) Animal mordants will fasten aniline dyes on cotton.

THE CHEMICAL NEWS.

VOL. XX. No. 515.

ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 159.)

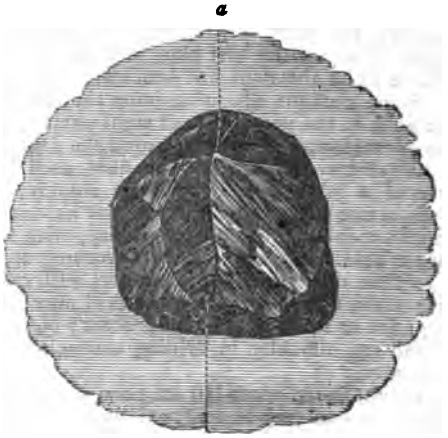
THE subject of the present chapter may be considered rather as mechanical than microscopical; in fact, it relates more to the workshop than to the study. It may, perhaps, seem strange to write about making apparatus and preparing materials in these days when nearly everything can be bought often better and more cheaply than it can be made at home, and when it is not as it was within the memory of many microscopists, who were obliged to cut their glass slides, or, at all events, to order a glazier to make them: but the more dexterous a person is with his fingers the better microscopist he is likely to make. Very often the success of an observation depends upon the observer being able to make some little contrivance to aid his researches, and it is for that purpose that the subject of the mechanics of the microscopical laboratory finds a place here.

The first material that engages the attention is glass. It comes under notice in several forms—the plates of glass upon which objects are mounted, the thin covering glass, and glass tubing. The glass generally used for mounting objects is a description of glass known as patent plate. Crown glass is sometimes used, but patent plate is perhaps the best. It is made from that commonly known by the name of cylinder glass, which is manufactured by the glass being blown, first of all, into a globe, then, by dexterous manipulation on the part of the workman, it is elongated, and a cylinder is formed. This cylinder is ripped up, and put in an annealing oven: it unbends at the slit, and rolls itself out flat. In this state it is known as sheet or flatted glass. The glass then undergoes the same treatment as plate glass. It is ground down and polished, and then it becomes the patent plate. It is a thin glass, with a beautiful surface, so accurately worked that the plates will adhere together if pressed, just as good specimens of ordinary plate.

The tool used for cutting glass is the well-known glazier's diamond. It seems to have nothing in common with ordinary cutting tools: an incision or scratch with a diamond or other instrument, such as a flint or chilled-steel point, will not make the clean fracture we are so familiar with when the cutting diamond is used by a skilled hand. The diamond would seem rather to act by inducing some molecular displacement than by any actual penetrative power that it possesses. This view would seem to be supported by the appearance presented by the glass adjacent to a diamond cut when examined by the microscope with the aid of polarised light, which shows that the glass has been subjected to some kind of strain. Rubies and sapphires, if worked to the form of the natural edges of the diamond crystal, will cut glass, but lose the power when the curved edge wears away. A very interesting paper on the fracture of glass and the action of the diamond, by Mr. F. H. Wenham, will be found in the *Microscopical Transactions* for 1868, p. 105. (See also *Holtzapffel*, "Turning, &c.," vol. i.)

There is some little art in using the cutting diamond: it is not any part of a diamond that will cut. It is very easy, indeed, to scratch with a diamond, but it is only in certain directions that it will make the so-called cut. The glazier's diamond (Fig. 13), when viewed under the binocular microscope, will be found to exhibit a well-defined and slightly curved edge, *a*, *b*. The diamond is carefully set so that this edge (which is a natural crystalline one) lies parallel with the oblong mounting, and, as the diamond requires to be held in an inclined position to secure a clean cut, the top of the setting is always bevelled to the proper angle. It is allowed a little play horizontally on a pivot, so that, upon placing the diamond in contact with a rule, it will always place

FIG. 13.



itself in the cutting direction, and, by keeping the end of the setting parallel with the glass, it will be in a position for cutting. It is then drawn along; and those who have seen a glazier cut glass will remember the curious noise which accompanies the operation—something between a ringing and a hissing: the sound is very different from a scratch. The glass breaks at the place upon being bent. With a little practice, the cutting of glass will be very easy indeed; but it is not worth while, as a general practice, to cut slides, as they can now be bought at a cheap rate: it is chiefly for exceptional purposes that facilities for cutting glass are of value. Sometimes a piece of glass of extra size or unusual shape is required, and then time is often saved by being able to do the work, instead of waiting until the services of a glazier can be obtained.

The other kind of glass employed in mounting objects is the thin glass for covers. The details of its manufacture are unknown to me. It is remarkable for its extreme brittleness. In cutting, the glazier's diamond is not employed, but a splinter known as the writing diamond. The operation is attended with some difficulty, as the glass is

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

very likely to crack and star under the diamond. This is best prevented by placing the thin glass to be cut on a piece of wet plate-glass, which affords support, and effectually prevents splitting and cracking. As in the case of the 3×1 slides, it is hardly worth while to cut up squares and circles of thin glass, as it can be easily procured of the opticians already cut into the most useful sizes, or, if required in large quantities, of the wholesale glass warehouses. Of course pieces of unusual sizes and shapes are sometimes required, and then the power of cutting becomes of value.

The writing diamond is also used for making marks and writing on glass. Some persons write the names of their objects on the glass instead of on a label: it has the advantage of durability, but is not so legible as an inscription on paper..

Sometimes it is required to drill a hole in a piece of glass. This is a matter of no very difficult accomplishment. A good hard drill, if it is kept moistened with turpentine, will, with a small amount of patience and labour, eventually work its way through a piece of glass. Care should be taken that the glass rests upon a cork bed, or something soft, but yet firm, to give it sufficient support, or it may break just before the point of the drill makes its way through. Perhaps the best plan is to begin on the other side when the drill has penetrated about halfway. Some persons are of opinion that dilute sulphuric acid, in the proportion of eight parts of water to one of acid, serves for moistening the drill better than turpentine. Of course the fluid used is the reverse of a lubricant: if oil were employed, the drill would not cut. The drills are best hardened by heating to redness and cooling suddenly with strong sulphuric acid. The edge requires working up from time to time upon an Arkansas stone, with oil. In drilling a thick piece of glass, the drill may require setting once or twice during the process; but I have never had any difficulty in drilling through a thick piece of plate.

The rough, sharp edges left on glass after cutting with the diamond may be removed by grinding with fine emery and water upon a smooth paving-stone or thick plate of zinc: the glass-cutters usually employ emery upon a lap or horizontal wheel.

For many cutting processes, tools made of corundum and shellac are very useful; this composition, in the form of wheels, files, hones, &c., of several degrees of fineness, can be obtained of Mr. D. Lyon, 43, S. John's Square, Clerkenwell, E.C. These tools, especially the wheels, are employed by dentists, in cutting and shaping the semi-vitrified porcelain used in the manufacture of artificial teeth. The use of the corundum composition in this country is comparatively recent, although it has been employed for centuries by the native jewellers of India.

Corundum is a crystalline mineral, identical, or nearly so, in composition with the sapphire, ruby, topaz, and amethyst, equally hard, but wanting in transparency and lustre. Emery is nearly similar, but occurs in a granular form, and does not cut so well, although there are many purposes for which it is more serviceable than the harder corundum.

These tools must be plentifully supplied with water when in use, as, unless kept cool, they soon lose their shape, which would be the case if used dry, as they would rapidly heat and melt with the friction of rasping and grinding a hard substance.

Glass plates may be smoothed, and even rounded at the edges, with the greatest ease, with a corundum file, and almost as quickly as brass could be filed. A tapering tool is useful for enlarging a hole drilled in glass; and the hones serve for grinding sections of substances too hard for the ordinary stones. As the material becomes better known, many other uses will, no doubt, be found for it.

Glass is frequently used by the microscopist in another form, that of tube. It is chiefly employed in making the dipping tubes, with which objects such as free swimming animals and deposits in water are taken up, and for the pointed tubes, or pipettes, with which small portions of fluids are removed and deposited where they may be needed. The manufacture of these bent tubes, or pipettes, is not a matter of difficulty. The processes of drawing glass tube to points, and bending, are very frequent in the laboratory. The best source of heat is obtained from the Bunsen burner, which gives a very large flame without smoke and of great heating power by the consumption of a mixture of air and coal gas. It can be obtained of the chemical instrument makers for a very small sum; a spirit lamp, however, will answer the purpose tolerably well if the wick is a large one. A piece of glass tube, in which it is intended to make a bend, should be heated to a slight redness, and then carefully and slowly bent to the required angle. If an attempt is made to bend a tube suddenly, it will produce a choke, or contraction, in the bend. It is also necessary to heat a considerable length of tube. Pieces of glass tube are very easily detached, by making a notch on them with the edge of a file, and they are then sure to break straight across; any length of glass tube can be cut off in this way. The process most frequently required to be performed by the microscopist is the drawing tubes out into pointed ends for pipettes. To effect this, heat the tube in the flame; when the tube has become sufficiently soft, it can be drawn out to any length and fineness you please. The rough edge at the cut ends of tubing may be taken off by heating the ends in the flame, which will melt the edges and leave them rounded. This rounding of the edges is, perhaps, effected more rapidly by using a blowpipe, which facilitates the fusion of the glass. Sometimes a pipette curved as well as pointed is required; there are many purposes for which it is extremely useful. This is easily made by a little variation of the other process; while it is being drawn out, give it a skilful bend at the proper moment. Always keep tubes of glass revolving while they are being heated, and do not heat them more than is absolutely necessary, as, when the tube is made very hot, it is extremely pliable, and likely to lose its shape. With a little ingenuity a number of useful things may be made out of glass tube. A variety of these pipettes will be found useful, and they are rather expensive to buy.

Glass, whether in the form of slides or thin glass, always requires cleaning. The best cleaning fluid is methylated spirit, which, as it is not subject to duty, and can be obtained cheaply, may be made free use of for this and nearly all the operations of the microscopist in which strong alcohol is required. Care must, however, be taken to obtain pure methylated spirit, and not what is commonly known as "methylated finish," which contains a small portion of shellac in solution, and is quite useless for all microscopical and laboratory purposes, and which is not unfrequently sold when methylated spirit is enquired for.

I am indebted to the Rev. J. B. Reade for the history of this adulteration. Formerly, methylated alcohol was allowed to be sold without a licence; but certain persons, finding that it was cheap, and not being particular about the flavour of methylic ether, used it for making grog. This fact coming to the knowledge of the excise authorities, its sale by unlicensed dealers was prohibited, unless containing shellac in solution, a mixture which would not spoil it for its chief use, that of varnish making, while, upon mixture with water, the gum would be precipitated, making a very disagreeable turbid compound. There is no difficulty in obtaining pure methylated alcohol in large towns, where one or more licensed dealers are generally to be found. It can be obtained perfectly pure, either in large or small quantities, of Messrs. Jackson and Townson, Bishopsgate Street, and of most other dealers in chemicals. It should not leave any residue upon evaporation, or become turbid when mixed with water; any spirit having these defects should not be used for microscopical purposes.

Great care should be taken that the cloths used for cleaning glass be perfectly free from soap or dirt, otherwise they will leave the surfaces of the slide covered with striæ. Old linen, or cotton cloths, are to be preferred to new ones; they should, before use, be boiled in water and common washing soda, to remove all soap left from former washings. They are then to be washed several times in clean water, until all trace of the soda is removed, and then dried, but not ironed, as the rough fluffy condition they will be left in is extremely favorable for cleaning glass. After the spirit is cleaned off with the cloth, any fibres that may be left from the cloth should be removed with a soft wash-leather.

Thin cover glass is treated in a similar manner, but, on account of its excessive brittleness, requires great care in cleaning. After a little practice, it is quite easy to rub it with the cloth and leather between the thumb and finger; but, should any difficulty be experienced, which may be the case with the thinnest kinds, it will be found that it can be rubbed with considerable force, without injury, between two discs of wood covered with wash-leather. The great thing in rubbing a brittle substance is to support it well behind; this is the whole secret of cleaning thin glass between the finger and thumb.

For joining together pieces of glass, and for attaching metal to glass, the cement known as marine glue is usually employed. It consists of india-rubber, shellac, and coal naphtha, combined in various proportions, according to the purpose for which it is intended to be used. It is, I believe, difficult to make in small quantities; but there is no trouble in obtaining it, as it is sold by most microscope makers. As this cement will only adhere to hot surfaces, it is necessary to have some means of applying a steady heat to the pieces of glass, &c., to be joined; and as this cannot be done by means of the unprotected flame of a lamp, a hot-plate is generally employed. This can be obtained, ready made, of the opticians; but a piece of thick brass plate, about 6 or 7 inches long and 2 inches wide, placed upon one of the rings of a retort stand, will answer admirably; it can be heated by means of a spirit lamp or gas flame placed underneath. Supposing, for example, it is required to attach a ring of glass or metal to a glass slide, to form a cell for an object to be mounted in. The glass slide is placed upon the hot-plate, first of all, at the part most distant from the lamp, to avoid breaking it by too sudden heating, and then moved gradually to the hotter part; the ring is also heated on the plate, a piece of marine glue is held on the point of a needle in a handle, or other convenient holder, and rubbed on the heated glass over the surface to which the ring is to be attached. When a sufficient portion of glue is melted on the glass, care being taken to heat the glue sufficiently for free working, while overheating amounting to boiling is to be avoided, the heated ring is then lifted on with a pair of forceps, which, for this and all purposes where they are likely to be made hot, should be of brass, or else an old pair of steel forceps, which are to be kept for such uses. The ring is then to be turned round backwards and forwards on the glass, to spead the cement equally, and then removed from the hot-plate and pressed on a piece of wood, to expel superfluous glue, and allowed a little time to set; when set, but still warm, the greater part of the cement can be scraped off with a blunt knife, a process much more difficult if it is allowed to become quite cold. A number of cells can be attached and roughly cleaned at one time, the plate next required being heated while the one cemented is being cleaned off. When quite cold, the slides can be thoroughly cleaned with a piece of rag and a free use of methylated spirit; they should then be rubbed bright with a clean cloth. Some persons use liquor potassæ for cleaning off superfluous marine glue; it does this very effectually, but not so rapidly as strong alcohol, and the operation is a rather unpleasant one, as the alkaline solution first softens, and then removes the skin from the fingers.

The adhesion of marine glue, and other cements, to glass surfaces, is much improved by grinding, which gives the cement a better hold than it would have on a polished surface, although marine glue will adhere well to polished glass, provided the surface is free from grease, which may be insured by a cleaning with methylated spirit. The adhesion of two pieces of glass cemented with marine glue is so perfect that they generally break in any place rather than at the joint.

(To be continued.)

ON THE

SOLVENT TREATMENT OF URIC ACID CALCULUS

AND THE

QUANTITATIVE DETERMINATION OF URIC ACID IN URINE.*

By the Rev. W. V. HARCOURT.

WHEN the British Association met at Manchester in 1861, Dr. Roberts, Physician to the Royal Infirmary of that city, communicated a paper respecting "The Power of Strong and Weak Solutions of the Alkaline Carbonates on Uric Acid Calculi,"† in which he showed the fallacy of the experiments supposed to have proved their inefficacy in a report formerly made to the French Academy by MM. Gay Lussac and Pelouze.

Dr. Roberts found that solutions of the carbonated alkalies containing more than 120 grains of the salt in a pint of water arrested their own action by forming an

* Read before the British Association, Exeter meeting, Section B.
† "Report of the British Association, Manchester, 1861," p. 90.

insoluble crust of biurate on the calculus, and that the maximum of solvent power lay in solutions which contain 50 or 60 grains in the pint. At this strength, no incrustation was formed when the carbonate of potash was employed; and 21·4 grains per cent of the weight of the calculus were removed by a flow over it of 6 pints in twenty-four hours. The carbonate of soda followed the same general course, with inferior efficacy.

In 1865, Dr. Roberts communicated to the Royal Medical and Chirurgical Society of London* a paper in which he showed, by a series of well-devised experiments, how this discovery might be applied, with a reasonable prospect of advantage, to medical practice; and laid, for the first time, a scientific basis for attempts hitherto empirical and contradictory at dissolving the stone. The most remarkable of these experiments was that in which he passed the urine of a patient who was taking citrate of potash at the rate of 40 grains in 5 ounces of water every two hours over a fragment of uric calculus, and, by this process, reduced it in twelve hours from 180·5 to 174 grains, or at the rate, in twenty-four hours, of 13 grains.

In July, 1868, I was made aware, by an eminent surgeon, Mr. Spencer Wells, of the presence of a stone in the bladder, one diameter of which appeared to measure 1½ inches; and I was advised by Mr. Wells (and by Sir H. Thompson, who confirmed his opinion as to the size of the stone), to aim at preventing its enlargement by such doses of citrate of potash as might keep the urine in a state approaching neutrality. In conversation with my excellent friend, the late Mr. Hodgson, who, when surgeon to the Birmingham Hospital, had had great experience in this complaint, I learned that he had met with so much success in the application of an empirical medicine of much celebrity, manufactured in that neighbourhood, and consisting of carbonates of potash, that, in any case of uric acid calculus, he would advise the experiment of its administration.

Mr. Wells afterwards drew my attention to the experiments of Dr. Roberts, which appeared so satisfactory that I determined to make trial of his method of treatment, and to ascertain, if possible, by chemical analysis, the excess of uric acid above the normal quantity contained in the urine which it might be considered as removing from the calculus.

I felt the great importance of the inquiry, and had the advantages of more than ordinary leisure, a long familiarity with chemistry, a well-furnished laboratory, and an assistant in executing the experiments on whose accuracy I could fully rely.†

I will now proceed to lay before the Section a short abstract of the chief results which I have obtained from an unintermitted course of careful experiments on all the urine voided during the past twelve months, some of which will be found of value to future experimenters, though, from causes which I shall describe, they have not realised all my expectations. If, as I had supposed, there had been any known chemical method of determining, with a near approach to accuracy, the amount of uric acid in urine, then the quantities of that acid which Dr. Roberts had found to be removed from calculi out of the body were abundantly sufficient to be ascertained by analysis, on the supposition that the same process went on in the bladder under the treatment recommended by him. I had scarcely, however, commenced my course of experiments before I became convinced of the fallibility of the methods in use for separating uric acid; and the experiments which I have to describe will place that fallibility in a strong point of view.

The method first employed was the ordinary one of adding 5 per cent of hydrochloric acid, allowing the mixture to stand forty-eight hours, and then, after decantation, collecting the uric acid on a small filter, washing it with distilled water, and drying it at 212° F. till it ceased to lose weight. The first seven determinations, from the 20th of August, 1868, to the 26th, inclusive, were made each day on the urine of the preceding twenty-four hours, in a neutral or slightly alkaline state, brought to that state by doses of from 120 to 165 grains of citrate of potash. The quantities of uric acid obtained varied from 11·08 to 8·43 grains. In the subsequent daily determinations, down to the 5th of September, acid reactions were interpolated, due to the use of smaller alkaline doses, which lowered, proportionably, the amount of uric acid obtained; and, when no alkali had been taken for two days, and the urine was, in consequence, strongly acid, the quantity of uric acid found was only 2·35 grains.

From this time commenced a course of large quantities of citrate of potash, amounting, during fourteen days, to 315 grains in twenty-four hours, taken in a state of effervescence, in doses of 45 grains, dissolved in 3 fluid ounces of water. For ten of these days, the hydrochloric acid was used to precipitate the uric acid; and the determination of this gave from 11·95 to 6·00 grains. In every case but the last, the whole urine of the twenty-four hours had been used; but, in the last, half was treated with hydrochloric acid, and the other half with the same proportion of nitric acid: that treated with the former acid gave 6·42 grains, while that with the nitric acid gave only 1·97 grains. On the following day, half the urine was treated by Lehmann's process, and gave 6·40 grains; half with nitric acid and acetic acid, in equal proportions, which gave 4·09 grains uric acid. The preference, however, assigned by Dr. Thudichum, in his able and well-known treatise on the "Pathology of the Urine," to nitric over hydrochloric acid as having given him better results led me to continue its use.

The quantity of citrate of potash taken was then raised to 350 grains for four consecutive days. On the first of these days, the uric acid found was 1·54 grains; on the second, 1·23 grains. These results were so extraordinary that, for the purpose of corroborating them, or discovering an error in the analysis, I sent 40 fluid ounces out of 61 fluid ounces voided on the latter day to Dr. Thudicum, who was so good as to furnish me with his analysis of it, containing the weights of sulphuric acid, phosphoric acid, chlorine, potash, urea, and uric acid which he had obtained. The uric acid amounted to no more than 0·775 grains.

This result led to one of two conclusions. Either independently of any question of the solution of the calculus the presence of uric acid in the bladder had been almost entirely prevented by the alkaline treatment, or the process for obtaining it was altogether unreliable. Taking the latter alternative as far the more probable, I endeavoured henceforward to improve the analysis. The mucus secreted from the bladder by the alkaline action being now a good deal in excess, I was advised that it would be prudent to diminish the quantity of alkali taken; and it was accordingly reduced, for five days, to 300 grains of the citrate, and, for eight days, to quantities varying from 270 to 240 grains. The alkalinity was now determined for every voiding with hydrochloric acid. 2·5 per cent of that acid was added to each; and, as it had been observed that uric acid was lost by decantation, however careful, the portions of urine operated upon were entirely filtered, and the water with which the precipitates were washed was acidified with acetic acid. Under this treatment, on the fifth day of taking 300 grains of citrate, the alkalinity, measured by a standard solution of hydrochloric acid, and estimated in grains of carbonate of potash, was 25·5 grains per pint. The uric acid obtained weighed 4·74 grains; and the series below 300 grains of citrate gave quantities of uric acid varying from 2·91 grains, the alkalinity being 23·05 grains per pint, to 8·42 grains, the alkalinity being 17·2 grains per pint.

One-half of that which, with 2·5 per cent hydrochloric

* *Medico-Chirurgical Transactions*, vol. xlviii., p. 89.

† My assistant, Mr. W^m P. Horn, learned, in Sir Benjamin Brodie's School of Chemistry, in Oxford, those habits of precision in manipulating and accuracy in observing which are essential to chemical experiments.

acid, had yielded 8·42 grains was treated with 5 per cent nitric acid, and kept at the temperature of 90° F.; and, to render the experiment analogous to Dr. Thudichum's analysis, the alkalinity and dilution were brought to a similar standard by additions of carbonate of potash and water. The uric acid thus obtained weighed 2·07 grains, showing a loss, by this method, of 6·35 grains.

The following table contains an account of the uric acid obtained on the thirty-five days from October 9th to November 12th, inclusive, as well as of the potash taken, and the quantity and alkalinity of the urine.

Citrate of potash.	Alkali, per pint.	Uric acid.	Urine voided, in ounces.
220	16·3	6·9	51·4
20	16·8	5·6	46·6
10	22·1	8·1	40·6
255	4·2	12·2	49·7
240	19·1	7·9	47·1
240	21·3	10·6	50·7
240	30·9	9·3	55·1
225	20·0	8·4	51·9
260	36·2	6·4	46·4
270	19·5	5·5	59·0
230	18·4	6·5	56·5
240	16·8	9·1	60·7
270	22·6	7·1	53·5
270	29·0	6·6	63·5
255	27·5	8·4	59·7
285	35·4	3·23	62·5
255	40·3	7·1	52·0
240	29·4	9·6	52·0
240	19·8	8·8	52·9
225	23·3	8·7	60·3
140	10·0	11·9	64·7
140	5·0	5·1	57·2
120	1·4	4·9	44·0
120	4·2	6·4	45·0
25	5·2	7·8	51·5
185	7·6	8·4	52·5
225	26·3	7·3	51·5
210	17·4	9·7	61·9
210	22·0	7·3	64·5
210	16·4	8·3	76·4
210	19·2	8·5	42·5
210	19·5	9·4	51·4
210	19·8	9·9	63·5
195	21·3	7·6	53·5
180	21·2	11·6	55·5

In this table, the highest quantity of uric acid, 12·2 grains, is connected with an alkalinity of 4·2, while the lowest quantity, 3·2, was obtained when the alkalinity was as high as 35·4. Twenty days, in which the alkalinity of twenty-four hours varied from 19·2 to 40·3, gave an average of 7·94 grains; whilst fifteen days, when the alkalinity was from 19·1 down to 1·4, gave an average of 8·08 grains. These data would lead to the supposition that the alkali had exercised no action on the calculus; but, on the other hand, the great and sudden rise of the uric acid, when the alkalinity descended from 22·1 to 4·2, might raise a suspicion that the alkaline treatment may reduce the secretion of uric acid, and, in that case, the absence of solvent action cannot be inferred.

A good deal of blood passed with the urine from the 13th to the 16th of November, accompanied with some diarrhœa and sickness. On the 17th, the determination of the uric acid was resumed; the alkalinity on that day being 5·3; the uric acid was 11·55 grains. On the following day, the acidity being 10·8, the uric acid was 10·38 grains.

I now instituted some new experiments, on the effect which different degrees of dilution in urine produce on the separation of uric acid. On November 19th, 40 grains of citrate of potash having been taken, the urine voided in twenty-four hours amounted to 31 fluid ounces; it was neutral; the sp. gr. was 1·032. It was divided into three equal portions, one-third in the natural condition treated in the usual manner with 2·5 per cent. Hydrochloric acid gave uric acid at the rate, for twenty-four hours, of 11·78 grains; one-third, diluted with its own bulk of water, and of sp. gr. 1·022, treated in like manner, gave uric acid 10·99 grains; one-third, evaporated down to half its bulk, and then heated with the same quantity of hydrochloric acid, gave, uric acid, 13·81 grains. November 22nd. 180 grains of citrate having been taken, the alkalinity being 1·96, and the sp. gr. 1·030, the urine for the twenty-four hours, amounting to 41·5 fluid ounces, was divided into two portions, one of which, in the natural condition, gave 12·32 grains, the other, concentrated to one third, sp. gr. 1·070, gave 14·78 grains of uric acid. On the 23rd, the same quantity of citrate being taken, the alkalinity, 18·05, sp. gr. 1·028, the quantity of urine, 42 fluid ounces, one-half in the natural condition, gave 12·72; the other half, concentrated to one-fourth, sp. gr. 1·072, gave 14·94 grains of uric acid. On the 24th, the same quantity of citrate being taken, the alkalinity, 20·4, sp. gr. 1·030, the quantity of urine 35 fluid ounces; one-half, in the natural condition, gave 10·318; the other half, concentrated to one-fourth, sp. gr. 1·074, gave 12·135 grains of uric acid. On the 25th, the same quantity of citrate being taken, the alkalinity, 21·2, sp. gr. 1·031, the quantity of urine 43 fluid ounces; one-half, in the natural condition, gave 9·94 grains; the other half, concentrated to one-fourth, sp. gr. 1·075, gave 11·02 grains of uric acid. Again, on the 30th, 155 grains of citrate having been taken, the alkalinity, 37·6, the quantity of urine, 40 fluid ounces; one-half, in the natural condition, gave 8·53; the other half, concentrated to one-third its bulk, gave 12·66 grains of uric acid.

These give very nearly the two extremes of difference in forty comparative experiments, in the last fifteen of which the urine was reduced to a standard volume of 6 or 3 fluid ounces, according as half or quarter of the urine was employed; the average difference in these fifteen was 3·03, and in the former twenty-five, reduced to the proportions above described, 3·09 grains. What was the cause of the variation in the differences does not appear; it occurred equally, whether the urine was acid or considerably alkaline.

It follows, I think, from these experiments, that, to any average quantity of uric acid obtained from an unconcentrated urine, 3 grains may be added; and the last experiment described in this paper makes it probable that the employment of a better method of analysis may increase this augmentation.

I was not satisfied, however, that sufficient accuracy of analysis had yet been obtained, and I have since employed the following process, which promises more perfect results:—A fourth of the urine of twenty-four hours is evaporated to 3 fluid ounces; it is treated with a mixture of hydrochloric acid and alcohol in equal parts, each being 2·5 per cent of the quantity of urine employed; it is allowed to stand for forty-eight hours, drained on a small filter, washed with alcohol (methylated spirit), and then with equal parts of acetic acid and water. The colouring matter and phosphates, &c., are thus removed, and the uric acid is of a light colour and perfectly, though confusedly, crystalline.

The advantage which this method possesses over those heretofore in use is shown in the experiment which follows:—In urine having an acidity of 5 grains per pint, the nitric acid method of Dr. Thudichum gave 1·16 grains of impure uric acid; the ordinary hydrochloric acid method gave 5·53 grains; the method above described gave 9·90 grs. of uric acid. I have found this method equally effective in the treatment of acid urine neutralised by potash, and am inclined to believe that it might be not less applicable to that which contains a greater amount of chloride of potassium.

On the whole, these experiments, though they have failed to realise my expectation of testing, by analysis, the effect of Dr. Roberts's solvent treatment on vesical

calculus, may serve to point out to others the road to success in such an attempt; and if they do so, the labour of a twelvemonth will not have been spent in vain.

There is one prominent chemical fact attending these experiments which remains to be noticed—viz., the greater amount of uric acid obtained before the alkaline treatment commenced, than in the last experiment by the same process, in the proportion of 9·56 to 5·53 grains. A similar diminution has taken place in the mineral acids; whilst from 120 to 150 grains of citrate of potash were required for neutrality in August, 1868, in March and April, 1869, from 30 to 60 grains sufficed for the same purpose. Dr. Thudichum's analysis, in September, 1868, gave—of sulphuric acid, 51·1 grains, of phosphoric, 45·7 grains. The analysis made in my laboratory, in March, 1869, gave—sulphuric acid, 25·9, of phosphoric, 34·2 grains, a difference scarcely to be accounted for without reference to the alkaline treatment undergone in the first three months of the interval.

Though I have been unable to produce any *chemical* evidence in favour of the solvent treatment, a fact observed during the whole course of that treatment, and not afterwards, persuades me that a solvent action was really going on. This fact consisted in a small amount of constant deposit, in which fragmentary particles of uric acid were discerned by the microscope, enveloped in mucus, and bearing, in the opinion of Mr. Wells, as well as my assistant, a close resemblance to the detritus left by the incomplete action of carbonate of potash on fragments of uric acid calculi. I suppose these to have been washed out of the bladder in consequence of a partial solution. That no such solution should have been brought into evidence by the many determinations of uric acid, however imperfect, which I have here described, if it cannot be fully accounted for by that imperfection, may possibly be due to a physiological effect of the alkaline treatment in preventing the formation of uric acid, which may have counterbalanced the excess expected from solution of the calculus. This point, a course of experiments which need not be very long, conducted by a process of analysis reliable within a tenth part of the weight of uric acid obtained, ought hereafter to determine.

My experience of the effect of doses of 300 grains of citrate of potash taken in twenty-four hours has convinced me that no disadvantage to health need be dreaded from such a course. I have not suffered so much from dyspepsia during the last twelvemonth as in many former years. Bleeding from the bladder has, indeed, supervened twice, but without any pain or irritation, and I have had no other symptom of the complaint; and this is the experience of a man of eighty years of age, who has been for some years an invalid.

PS. I have omitted to state that the calculus was judged to be uric from the previous passage of crystals of uric acid. Since the alkaline treatment, the urine has been perfectly clear, free from all deposits. It was never ammoniacal when voided, and contained no albumen.

ON SOME

REACTIONS OF CHLOROSULPHURIC ACID.*

By JAMES DEWAR, F.R.S.E., and GEORGE CRANSTON, Edinburgh.

During the course of several experiments on the action of chlorosulphuric acid on phenol, we have noticed one or two decompositions with simple carbon compounds that may be of some interest. Since Kekulé's researches on the phenol sulpho-acids, chemists are agreed that, in these acids, the radical HSO_3 functions as a monadic group. It was but natural to expect that, if we substituted chlorosulphuric acid for sulphuric acid in forming these compounds, we should arrive at similar bodies, with this difference, that, in the one case, we should eliminate the hydrogen of the group acted on as water, and, in the other, as hydrochloric acid. Now, a critical examination of recent researches in the aromatic derivatives shows that certain groups or elements used as substituting agents tend to approach or separate, thereby producing isomeric compounds: for instance, Korner's celebrated synthesis of resorcine starts from dinitrobenzine, where the relative position of the two NO_2's is maintained throughout the number of complex compounds through which this chemist passed in order to replace the NO_2's by hydroxyls. But, if we examine the intermediate compounds produced, it is evident that, if we could change the conditions or modify the relations of the substituting groups, we might arrive at the same products by direct substitution. Thus the dionitrobenzine produced in the second stage of the fore-mentioned synthesis might be made directly if we could form nitro compounds by some reagent other than nitric acid. The experience we possess at the present time is too meagre to admit of any attempted prediction of what would be the effect of substituting the same radical from different sources.

It was our intention to have investigated one reaction from this point of view, and we chose, for this purpose, an examination of the sulpho acid, or acids that would be produced by the action of chlorosulphuric acid on phenol, as compared with the sulpho acids produced when sulphuric acid is used. We were engaged in this direction when Engelhardt published his interesting paper bearing on this point. We have, however, noticed one or two reactions of this substance that may be acceptable at the present time.

The chlorosulphuric acid used in this investigation was prepared by the direct action of sulphuric acid on hydrochloric acid. We found the reaction to go with great ease and rapidity, the temperature of the sulphuric acid, containing a large percentage of sulphuric anhydride, rising to 120° C. The substance had all the properties ascribed to it by Williamson. In our first experiments, we attempted to prepare the acid by acting on sulphuric acid with pentachloride of phosphorus, as described by Williamson. We found it impossible to free the chlorosulphuric acid completely from oxychloride of phosphorus.

We attempted the formation of Kolbe's trichlormethylsulphurous acid by the action of chlorosulphuric acid on chloroform, expecting $CHCl_3+Cl(HSO_3)=CCl_3(HSO_3)$. We found that, when equivalent quantities of chlorosulphuric acid and chloroform were heated in a sealed tube to 120° C., instead of obtaining Kolbe's acid, we got the decomposition products of this acid—sulphurous acid, hydrochloric acid, and chlorocarbonic acid, thus—$CCl_3(HSO_3)=CCl_2O+HCl+SO_2$. The pressure in the tubes being so enormous, we found them extremely liable to burst. No doubt tetrachloride of carbon would give a similar decomposition, with the difference that SO_2Cl_2 would be produced simultaneously. This reaction is interesting, as Schutzenberger has just shown the formation of phosgene gas by the action of sulphuric anhydride on tetrachloride of carbon.

We have examined, also, the action of chlorosulphuric acid on bisulphide of carbon. When equivalent quantities of chlorosulphuric acid and bisulphide of carbon were heated in a sealed tube to 100° C. for some hours, we found the non-miscible liquids changed into a clear, mobile liquid, from which had deposited large yellow crystals of sulphur. The tubes, when carefully opened, continued to evolve gas until the whole of the mobile liquid disappeared: the liquid was condensed sulphurous acid. The gas was collected over water, when a large quantity was rapidly absorbed. The gas not absorbed after it had stood for some time over water we have carefully examined, and found to have all the properties of oxysulphide of carbon. This reaction is interesting as showing the formation of oxysulphide of carbon by direct

* Read before the British Association, Exeter meeting, Section B.

substitution of sulphur in bisulphide of carbon by oxygen. The reaction is evidently—

$$CSS + Cl(HSO_3) = CSO + HCl + SO_2.$$

Probably the reaction would succeed better by the action of sulphuric anhydride on bisulphide of carbon. In this case, the pressure in the tubes would be greatly diminished by evading the presence of the hydrochloric acid gas. Lautenberg has recently shown the formation of oxysulphide of carbon in many reactions; and this is another instance in which it is produced.

THE PREPARATION OF SESQUICHLORIDE OF CARBON.

By H. BASSETT, Esq.

THE vapour of tetrachloride of carbon is passed moderately slowly through a glass tube about 30 inches long, kept at a moderate red heat. The end of the tube fits into a quilled receiver, provided with a tube to carry off the excess of chlorine. The liquid condensed is dark yellow, from the chlorine held in solution, and consists of sesquichloride of carbon, C_2Cl_6, and the liquid chloride, C_2Cl_4, with unaltered tetrachloride. It also contains a very small quantity of the chloride C_6Cl_6.

On exposing this liquid to a good light, the excess of chlorine is absorbed by the C_2Cl_4. It is then distilled with a thermometer. When the temperature has risen to 150°—160°, the residue in the retort consists almost entirely of C_2Cl_6, retaining the trace of C_6Cl_6 and a little impurity, which gives it rather a dark colour. It is poured out into a dish, when it soon becomes solid, and may be purified by crystallisation, or by distillation with the vapour of water. The distillate under 160° is then saturated with chlorine in a good light, when the whole of the C_2Cl_4 is converted into perfectly white C_2Cl_6, which is easily separated from the unaltered CCl_4 by distillation.

In this manner there would be no difficulty in preparing the sesquichloride in any quantity.

ON A VERY CONVENIENT METHOD OF ASCERTAINING THE CONSTITUTION OF FLAMES.

By M. L. DUFOUR.

M. DUFOUR recommends the following process for demonstrating, for instance, that the flame of a candle is formed of a hollow cone, luminous on the outside only, and dark in the interior. For this purpose it is necessary to cut the flame; the most preferable method of doing this is by means of a sheet of water or air. The arrangement is as follows:—A caoutchouc tube has, at one of its extremities, a gas jet, such as is used for common gas flames; this jet has an almost semicircular slit of 0·4 m.m. in depth. The other end of the tube communicates with a reservoir of water placed at a convenient height. Upon a suitable pressure, the water flows out by the slit in the jet, producing a clear sheet capable of preserving, for a sufficient length of time, an invariable form and size. The slit is placed in such a manner that the sheet presents a horizontal surface; and this will easily cut the flame of a candle, showing a perfect section. The hot gases and carbonaceous particles are carried off by the water. On placing the eye above the hollow cone, the luminous wall, &c., can be distinctly seen. Sections may easily be made near the wick or near the point; nothing hinders observation, which may be prolonged at pleasure, and a lens may be used if desired. A flame of gas may be cut and examined in the same manner, but the current of gas must not be strong enough to traverse the sheet of water. If a current of air be caused to come out of the slit by bellows, an invisible sheet of air is formed which is, also, very convenient for making a section of flame. Close observation is quite possible; for the aërial current prevents the heated gases from reaching the eyes, and a lens may be used, as in the former case. The flame forms a cone, whose luminous walls are extremely thin, and their interior can be plainly seen. A platinum wire may be introduced across the section; and, on being plunged as far as the wick, it will remain unreddened in the dark interior of the cone.

A jet of gas issuing from a circular opening, of from 1 to 2 m.m. in diameter, may also be cut very conveniently by the sheet of air. It will be seen to consist of a cone whose walls are brilliant and extremely thin. Upon bringing the sheet of air close to the aperture whence the gas escapes, the flame will be divided at its base and will reappear a little higher. By this means, the entire length of the luminous cone, its thin walls, and their interior may be examined.

If a jet of gas produced by a fan-tail burner be cut, the luminous fan will be found to consist of two brilliant blades, between which there is a narrow obscure space. The blades are at a greater distance apart, and the dark space is wider towards the end of the fantails; and, by assuming a suitable position, it is easy to see through the section of flame into the dark space which separates the brilliant walls, and at the end of this will be seen the slit by which the gas escapes.

Instead of throwing the sheet of air perpendicularly to the flame, M. Dufour thinks it better to throw it partly on one side, on such a plane as to make a slight angle with the axis of the conical flame, or with the plane of the fan-shaped flame. A lateral suction is then produced by the influence of the current, which draws the flame, and inclines it against the sheet of air, by which it is cut. By placing the sheet of air on a more or less inclined plane, and approaching or removing it from the base of the flame, the section is easily made at points more or less distant from that base.

The method described above may, of course, be applied to any kind of flame. M. Dufour suggests that it might be of service in the chemical analysis of flames. When a flame is cut by a sheet of water, the water draws off the gases of which it is composed. If the section be made with a sheet of air, it will be easy, by placing suction pipes throughout the length, and ending at fixed points in the interior of the cone, to collect the gases whose composition is desired to be ascertained.—*Les Mondes.*

THE ECONOMICAL PURIFICATION OF ZINC CONTAINING IRON.

By W. H. CHANDLER.

IN the galvanising of iron, the article to be galvanised, after being thoroughly cleansed, is dipped into a kettle of molten zinc, which forms an alloy with the iron at the surface of contact, and by repeating the dipping the thickness of the superimposed zinc may be increased at pleasure. In the prosecution of this manufacture, the zinc is held in large iron troughs or kettles, which are rapidly corroded in those portions nearest the fire. An alloy of zinc and iron is formed, to which also the articles, being galvanised, in some degree contribute. This alloy being heavier than the purer zinc, sinks to the bottom, and, from time to time, is removed by perforated ladles.

The composition of the alloy is of course somewhat variable, depending upon the temperature and fluidity of the zinc and the careful straining from the fluid metal.

The two analyses here given were made by the writer a number of years since:—

Zinc	94·27	94·15
Iron	5·46	5·00
Lead	0·27	0·56
Tin	trace	0·29
	100·00	100·00

These samples were taken from a re-melting of a large quantity of the alloy, which is the only practicable method of obtaining a fair, average specimen.

The quantity of this dross or refuse is quite considerable, amounting probably, in the United States, to several hundred tons per annum. Formerly it was sold for use in coarse brass castings, and to some extent it was re-distilled. At one establishment in Boston circular clay retorts, similar to those in use in the gas manufacture, were employed, the molten alloy being introduced through an inverted syphon in the iron mouthpiece and the condensing tube, connected with the reverse end of the retort, dipping in a pot of molten zinc; thus all access of air to the interior of the retort was prevented, and little or no oxidation of the zinc occurred.

Several years since, a small lot of this refuse zinc was received at a metallurgical establishment in Massachusetts, in which the writer was employed as chemist, and, in experimenting upon it, one of the foremen of the establishment originated a method by which the zinc could be obtained quite free from iron. Finally, after re-building his furnaces and in various ways altering and modifying his manipulations, the samples of purified zinc being analysed after each alteration of the process, a good commercial article was obtained containing only one-tenth of one per cent of iron.

The process consists in melting the refuse in an iron kettle, raising the heat nearly to the point of volatilisation of the zinc, and then, by a proper regulation of the heat, cooling the mass slowly from the bottom, by means of a special arrangement of flues. An alloy of zinc and iron, containing a much larger percentage of iron than the original refuse, gradually forms, falls to the bottom of the kettle, and is removed by a perforated ladle, while the fluid metal is much purer. The quantity of alloy to be ladled out depends upon the impurity of the original refuse. The purified zinc and the concentrated impurity are melted in separate kettles, and each treated as in the first operation.

One more fusion and refrigeration of the purified zinc and the still more impure zinc, render the former a good commercial spelter and the latter too impure for further economic treatment.

This process is the reverse in its reactions from Pattison's process for desilverising silver-lead ores. In the latter case the purer lead crystallises from the more fluid lead and silver, whereas in the former, the more impure alloy separates from the purified zinc.

The residue from this process, which is sold for distillation, consists of hexagonal prismatic crystals of a fixed alloy of iron and zinc, loosely agglomerated together so as to crumble in the hand.

When the operation of refining is badly conducted, more or less zinc acts as a solder for the crystals. They are beautifully iridescent, exhibiting all the colours of the rainbow, owing to a surface oxidation. A number of specimens of various colours were selected for analysis and showed a composition of—

Zinc	90·50
Iron	9·50
	100·00

Upon fusing these crystals, which requires a high temperature, and cooling as before, a small percentage of purified zinc is obtained, and an alloy containing as much as 12½ per cent of iron. This is compact, somewhat brittle, and exhibits no evidences of crystallisation.

This last-mentioned fusion is not made in practice, as the great heat required for its accomplishment rapidly burns out the iron kettles.

By a similar process lead has been removed from zinc with great accuracy, the amount obtained closely approaching the quantity therein. From a lot of Silesian spelter was separated lead perfectly malleable, and containing scarcely a trace of zinc. The purification of the lead, obtained from the process of desilverisation of silver-lead by means of zinc, could undoubtedly be accomplished by a modification of this process.

NOTICES OF BOOKS.

On Fresh Meat Preservation. By John Gamgee. London: Robert Hardwicke. 1869.

We have, in a pamphlet bearing the above title, an address delivered by Mr. Gamgee before the Board of Agriculture of Amherst (Massachusetts), on a mode of preserving meats for an indefinite time. After many trials, the process which was found to act best was the exhaustion of air from the vessel containing the meat to be preserved, and the introduction of various vapours. Among other substances, the following were tried:—Ozone, chloroform, ether, tetrachloride of carbon, bichloride of methylene, carbolic acid, chlorine, hydrochloric acid, and binoxide of nitrogen; but these were ultimately abandoned for sulphurous acid, introduced into the preserving vessel condensed in the pores of charcoal. "I believe," writes Mr. Gamgee, "that charcoal, saturated with sixty-five times its volume of sulphurous acid, will remain, to the end of days, the cheapest, most manageable, and most universally employed antiseptic that the meat preserver can use. It is, perhaps, bold to predict, that which I do with the greatest confidence, that charcoal and sulphurous acid will, in a few years' time, to a great extent, supersede the use of salt." For various reasons, however, sulphurous acid could not be used alone; and the experiments of Hoppe Seyler suggested the simultaneous employment of carbonic oxide, as it was found to preserve the colour of the meat and to expel the oxygen from the tissues; it also acted as a neutral gas to surround the meat in air-tight vessels in place of atmospheric air. The meat to be preserved was placed in a vessel capable of being exhausted by an air-pump; lumps of charcoal saturated with sulphurous acid were then added, and the vessel was exhausted as completely as possible; carbonic oxide was then introduced until the normal atmospheric pressure prevailed within the preserving vessel. Meat thus preserved was found to keep perfectly, not alone in closed cans, but in open vessels, and it could not be distinguished, as regards taste, from recently killed meat. Of course the chief obstacle to the adoption of the process is the expensive nature of the apparatus, and attempts have been made to displace the oxygen from the neighbourhood of the meat, by driving carbonic acid through the preserving vessel by means of a fan; it is obvious, however, that the tissues would still remain charged with oxygen. Whatever may be the value of this process on the large scale, there can be no doubt that few inventions could, at the present time, be of greater value to the human race at large than one which would secure the utilisation, as food, of the thousands of tons of meat which are now wasted in Australia and Texas, and the Argentine Republic. To allow myriads of oxen to attain maturity, and to destroy them for the sake of their skins alone, seems an act comparable to that of the Roman Emperor who caused several hundred flamingoes to be destroyed that he might be provided with a dish of their tongues.

Cleveland and its Metropolis. September 21st, 1869. Middlesborough-on-Tees: Printed at the *Gazette* Steam Printing Works. 1869.

We have received this neat little pamphlet accompanied by a very good map of the district. Its pages contain a very large amount of diversified information, written and compiled with care, and published especially for the information of those members of the Steel and Iron Institute, who, on the occasion of their first provincial meeting at Middlesborough, repair thither and are strangers to the district. We have an historical and archæological review of Cleveland, next a brief but very comprehensive account of the geology of this part of the county of York, followed by a brief history and description of the municipal and parliamentary borough of Middlesborough. The last two pages are devoted to the quotation of analyses of ironstone of this district, coke, best Durham, Weardale limestone, Forcett limestone, pig-iron, No 1, Acklam ironworks, and an analysis of grey-coloured slag. The authors of these analyses are Messrs. Crossley and Pattinson. At the end of the work a short description is given of the Acklam Ironworks, owned by Messrs. Stevenson, Jaques, and Co. The map which has been sent along with this pamphlet has been published by Messrs. Gillan, Schmitz, and Co., iron merchant and shipowners, Middlesborough and Glasgow, is excellently executed, and deserves creditable notice, especially since this kind of very useful publications, showing as it does the blast furnaces, rolling mills, &c., is too much neglected in this country. Maps indicating the different local industries of a county are very useful, and the getting up and publishing of them deserve every encouragement.

MISCELLANEOUS.

Method of Producing upon Iron a Durable Black Shining Varnish.—M. Weiszkopf.—Take oil of turpentine, add to it, drop by drop and while stirring, strong sulphuric acid, until a syrupy precipitate is quite formed, and no more of it is produced on further addition of a drop of acid. The liquid is now repeatedly washed with water, every time refreshed after a good stirring, until the water does not exhibit any more acid reaction on being tested with blue litmus paper. The precipitate is next brought upon a cloth filter, and, after all the water has run off, the syrupy mass is fit for use. This thickish magma is painted over the iron with a brush; if it happens to be too stiff, it is previously diluted with some oil of turpentine. Immediately after the iron has been so painted, the paint is burnt in by a gentle heat, and, after cooling, the black surface is rubbed over with a piece of woollen stuff dipped in, and moistened with, linseed oil. According to the author, this varnish is not a simple covering of the surface, but it is chemically combined with the metal, and does not, therefore, wear off or peel off, as other paints and varnishes do, from iron.

Oxidation of Ammonia.—Chemists are acquainted with the experiment for showing the oxidation of ammonia, in which a red-hot spiral of platinum wire is introduced into a bottle containing a thin layer of strong ammonia on the bottom; white fumes appear of nitrite and nitrate of ammonia. This experiment may be made far more conspicuous in the following manner:—Take a piece of combustion tube, about 40 or 50 centims. in length; place in the middle thereof a layer of 4 or 5 centims. of platinised asbestos. At one of the open ends of the tube a rolled-up piece of blue, and at the other end a similar piece of red, litmus-paper is placed; the last-named open end of the tube is connected, by means of properly arranged tubing, with a flask containing liquid ammonia; the other open end of the tube, where the blue-coloured litmus-paper is placed, is similarly connected with a flask filled with air. The platinised asbestos is next heated to redness, and kept in that state by suitable means. By the employment of a properly arranged tube, a current of air is slowly blown through the flask containing ammonia; when this is continued for a few moments the red litmus-paper will be observed to become blue, and the blue litmus-paper, at the other open end of the tube, will be seen to become red, whilst, at the same time, there will be deposited at the colder portions inside the tube, behind the red-hot platinised asbestos, a broad white ring of nitrite and nitrate of ammonia, while red vapours begin to fill the empty flask. When the gas, after having passed over the platinised asbestos, is made to come into contact with a strong solution of protosulphate of iron, to which some few drops of sulphuric acid have been added, this solution soon becomes deep blackish brown. A solution of iodide of potassium, to which a clear starch paste has been added, is, on being brought into contact with this gas, instantaneously coloured blue; while a strong solution of indigo in concentrated sulphuric acid, after having been gently heated, is very rapidly decolourised on coming into contact with this gas.—*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, September 27, 1869.

This number, an unusually thin one, opens with a brief, but very touching speech of M. Dumas, announcing the demise of the late Master of the British Mint, who was a corresponding member of this institution. The eminent speaker dwelt for a few moments on the great scientific merits of the deceased, pointing out his discoveries and researches, and expressing regret at the loss of such an eminently distinguished *savant*.

The following are the original papers and memoirs relating to chemistry contained in this number:—

Action of Permanganate of Potassa upon Asparagine.—M. Campani.—Asparagine is converted, by the action of water alone, into aspartate of ammonia. According to this author, asparagine is converted, by the oxidising action of permanganate of potassa, into ammonia, oxalic acid, carbonic acid, and a trace of hydrocyanic acid.

The Vacuum as a means of Preventing Explosions in Coal-Pits.—M. Raffard proposes that, on Saturday evenings, all the shafts of a coal-pit, one only excepted, shall be hermetically closed, and that that shaft shall be put into communication with an air pump, which, on withdrawing the air, will cause the marsh gas, fire-damp, freely to issue from the pores of the coals, and thereby cause a thorough cleansing of the air of the pit. It is very difficult to imagine that such a proceeding will have any really useful effect.

New Hygrometer.—M. Crestin.—The author proposes to place, on the plate of an areometer, a quantity of perfectly dry common salt; the areometer is then placed in pure water, which is covered by a layer of oil. While the salt absorbs moisture, the areometer gradually sinking into the water indicates the degree thereof.

Chinese Industry.—M. Champion.—The author has published a work on the ancient and modern industries of the Chinese Empire. This work is highly spoken of by M. Dumas, who points out that the Chinese excel Europeans in many matters.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 13, 1869.

From the proceedings of the meeting of this Society, held under the presidency of Dr. A. W. Hofmann, on the 12th of July last, and recorded in this number, we find, among the foreign gentlemen elected members of this Society, the names of Prof. Abel, of Woolwich; Dr. E. H. Kinson, Sandhurst, Farnborough; and Dr. W. Odling. The following papers and communications were read:—

Constitution of Tourmalin.—M. C. Rammelsberg.—In the introduction to this essay, the author points out the difficulties which beset this subject, which has frequently been worked at by various mineralogical chemists; but, notwithstanding the author himself made a large number of analyses of this mineral, several points of interest were not clearly elucidated, among these—(1) The behaviour of tourmalin on ignition; (2) the degree of oxidation of iron, forasmuch as this metal occurs in this mineral, which is not the case with all varieties thereof; (3) the precise quantity of boron contained in tourmalin. Tourmalin is a very complex mineral; it contains the following elements:—H, K, Na, Li, Fl, Mg, Ca, Mn, Fe, O, Si, B, and Al. Tourmalines are found not containing Li, Fe, Mn, or Ca. The colourless, or pale red-coloured tourmalin, from Elba, contains 0·2 per cent of MgO; a brown variety, from Windischkappel, contains 11·8 per cent MgO; the black tourmalin, from Andreasberg, contains 17·4 per cent FeO. Magnesia tourmalines are yellow or brown-coloured; the magnesia-iron tourmalines are dark brown or black-coloured; iron tourmalines are quite black-coloured; and the tourmalines which do not contain any iron at all but manganese, are rose or pink-coloured, or sometimes even colourless. As regards the fundamental composition of this mineral, it is a tri-silicate—

$$\underset{\text{I}}{R_6}\underset{\text{II}}{SiO_5}—\underset{\text{VI}}{R_2}SiO_5—RSiO_5.$$

The author proceeds at length, enumerating the various species of this mineral, according to the prevalence therein of certain elements; but, strictly speaking, this portion of his paper rather belongs to

mineralogy, and our space, moreover, forbids us to quote the large number of formulæ required to elucidate this subject.

On Chloral.—MM. Martius and Mendelssohn-Bartholdy.—The authors state that they have been induced to try whether it would not be possible to prepare chloral in large quantities, so that if this substance should become used in pharmacy, it could be obtained in a pure state. The hydrate of chloral would, according to the authors, answer this purpose by far the best. This hydrate ought to be a white crystalline mass, endowed with considerable hardness; it should dissolve readily in water, and be devoid of any smell of chloride of carbon or hydrochloric acid, while it should exhibit its peculiarly strong smell. The authors exhibited at this meeting several pounds' weight of chloral, and stated that they hope shortly to be able to exhibit to the members of this Society the synthesis of chloroform by an easily executed method, as also trichloracetic acid, made according to M. Liebreich's method.

On Euxanthon.—M. A. Baeyer.—According to the researches of the late Prof. Gerhardt, the euxanthon, obtained by M. Erdmann from the euxanthinic acid contained in Purrhee, should be composed according to the formula $C_{10}H_8O_8$. The author found that, when vapours of euxanthon are passed over powder of zinc heated in a combustion tube, there is formed a semi-solid hydrocarbon, resembling diphenol; and he concludes, hence, that euxanthon is not a derivative from naphthaline, but has to be referred to a benzol containing four atoms of carbon in a peculiar form. The author, on treating euxanthon with bichromate of potassa and sulphuric acid, did not succeed in obtaining products of oxidation of euxanthon, since the reaction became too violent; but, on fusing euxanthon with caustic potassa, a new substance was obtained, which the author calls euxanthonic acid, $C_{13}H_{10}O_8$. It is a weak acid, which yields, with basic acetate of lead, a reddish yellow-coloured precipitate; with chloride of iron, it yields a red colouration; euxanthon, on the contrary, yields, with that reagent, a green colouration. Euxanthonic acid is far more readily soluble in water than euxanthon.

Synthesis of Picolin.—M. Baeyer.—When acrolein-ammonia is submitted to distillation, an aqueous ammoniacal fluid and a basic oil are obtained. M. Claus discovered that the double salt of platinum of that base possesses the same composition as the picolin platinum salt, $NC_6H_7Cl.PtCl_2$; but the properties of that salt do not at all remind one of picolin. The author of this paper found that the aqueous ammoniacal fluid, which has not been investigated by M. Claus, contains a large quantity of picolin, and this picolin exhibits the very identical properties possessed by the picolin obtained from coal-tar and bone distiller's tar. The author explains the origin of picolin in the following manner:—Fatty substances yield acrolein, and, under the joint influences of ammonia and a high temperature, picolin is formed, according to the following formula:—

$$2C_3H_4O + NH_3 = NC_6H_7 + 2H_2O.$$

Derivatives from Naphthaline.—MM. Darmstädter and Wichelhaus.—The authors continue in this paper the communication of the results of their experiments on this subject, and describe, at great length, how they succeeded, by a very complex process, in obtaining bicyanaphthaline—

$$C_{10}H_6\begin{cases}CN\\CN\end{cases}$$

This substance exhibits needle-shaped pale yellow crystals, difficultly soluble in alcohol and ether, insoluble in water, and fusing at 204°. From this substance, the authors have prepared a compound which they call bicarbonaphthalinic acid—

$$C_{10}H_6\begin{cases}CO.OH\\CO.OH\end{cases}$$

This substance is a solid crystalline material, very difficultly soluble in boiling water, soluble in alcohol, not fusible nor decomposed at 240°. The authors refer, in this paper, to three varieties of bicyanaphthaline, in addition to the substance of that name already alluded to, and each obtained from a different naphthaline compound.

Action of Fusing Hydrate of Potassa upon Stearolic Acid.—M. S. Marasse.—The author, after referring to the labours of Messrs. Frankland, Duppa, Overbeck, and others, on this subject, states that stearolic acid is not a substituted acrylen, but that the molecule of this acid contains twice the group C=C. Acting upon this idea, the author has succeeded in so managing the action of the fusion with hydrate of potassa as to obtain from stearolic acid a homologue of acrylic acid. The new acid thus obtained is a colourless fatty matter fusing at 21°; its formula is $C_{16}H_{30}O_4$.

Constitution of Benzol.—M. A. Kekulé.—Unless we reproduce the woodcuts annexed to this paper, and essential to its proper elucidation, we cannot usefully give an abstract of it.

Crotonaldehyde.—M. A. Kekulé.—This paper contains the results of a series of experiments, made with the view to prove, experimentally, the mode of the combination of the atoms of carbon in benzol. The paper is too lengthy, and so crowded with formulæ, that it is impossible to give a proper abstract of it.

Lecture Experiments.—M. Kessler.—No. 1. Ignition of a mixture of H and Cl by means of the flame of CS_2 burning in NO, is rather awkward to manage. The author uses the magnesium light for that purpose. After having fastened a bottle filled with H and Cl to a retort stand, a piece of magnesium ribbon is taken hold of with a pair of forceps, ignited in the flame of a spirit-lamp, and moved, close to the bottle, up and downwards. A slight shock indicates the end of the reaction. The bottle is next opened under water.—No. 2. When burning magnesium wire is placed in a vessel containing CO_2, the latter is decomposed, and carbon deposited. Some HNO_3 should be poured into the vessel at the end of the reaction, in order to dissolve some magnesia resulting from the combustion, and to make the deposit of C distinct.—No. 3. Water having been poured in a rather wide-mouthed flask, it is made to boil as briskly as possible. When, after this boiling has been continued for some time, previously-ignited magnesium wire is held deep down in the mouth of the flask, it continues to burn. The same metal burns with great brilliancy in N_2O and NO, also in H_2S and SO_2, but is extinguished by CO. The floating of soap bubbles upon CO_2 is exhibited with the least expenditure of that gas when it is made to pass through the narrow neck of a large glass funnel.

On Diazocyanbenzol.—M. P. Griess.—This paper contains a first instalment of the results obtained when experimenting on the products of decomposition of diazocyanbenzol. Among these, the author found diazocyanbenzolimid—

$$\left.\begin{matrix}[C_6H_3(CN)N_2]''\\H\end{matrix}\right\}N + 3NHBr.$$

This substance is a solid body, almost insoluble in water; readily soluble in warm alcohol; crystallising, from the solution in that fluid, in large needle-shaped bright yellow-coloured crystals; fusing at 57°, and exploding when more strongly heated. Iodinecyanbenzol, also a solid substance, insoluble in water, readily soluble in alcohol and ether, and fusing at 41°.

Some Derivatives from Anethol.—M. Ladenburg.—After referring to his former researches on this subject, the author states that he has succeeded in obtaining anol, a solid substance fusing at 92·5°; soluble in alcohol, ether, and chloroform; and boiling at 256°. Formula, $C_9H_{10}O$. Chloranethol is a somewhat yellowish-coloured fluid which solidifies at a low temperature, and becomes fluid at −6°; boils at 257°; sp. gr., 1·1154. When this body is treated with caustic potassa, and heat applied, there is formed a substance, $C_{10}H_{10}O$; it is a liquid insoluble in water, and boiling at about 242°.

Chrysophanic Acid.—M. Rochleder.—When this acid is distilled along with powdered zinc, anthracen is formed. After this statement, the author proceeds to discuss the formula which chrysophanic acid ought to have, and, having found that chrysophanic acid, dried at 100° (all analyses made of this substance have been made with quantities thereof which were dried at that temperature), retains water, which can only be expelled at 115°, aided by a current of dry carbonic acid gas. The author ascribes to this circumstance the discrepance of the results of the elementary analyses made of this substance, and suggests that the formula of the acid dried at 100° should be written $4(C_{14}H_{10}O_4)+OH_2$. The author also found that chrysophanic acid made from rhubarb root is always contaminated with emodin; but this substance being soluble in a hot solution of carbonate of soda, wherein chrysophanic acid is insoluble, the two may be separated from each other in that manner. Emodin may be precipitated by acids from its alkaline solution, and, after having been carefully washed with water, may be dissolved in alcohol 80 per cent, and obtained in crystals on evaporation of that solution. Emodin exhibits an orange-yellow colour. The chrysophanic acid which has been separated, as described, from emodin, should first be well washed with water, and next repeatedly treated with boiling alcohol of 90 per cent, and thus obtained in pure state. So purified, the formula for dry chrysophanic acid is $C_{14}H_{10}O_4$.

On Naphthaline Red.—Dr. A. W. Hofmann.—At the Paris Exhibition of 1867, there was only one naphthalin colour exhibited, to wit, the naphthaline yellow (dinitro-naphthol) discovered by Dr. Martius. The author says that he has received, from his friend M. Scheurer-Kestner, a quantity of a very remarkable substance, now known as naphthaline red on the continent, and in England designated Magdala red. This substance, as sent to Dr. Hofmann, exhibits a blackish brown, somewhat crystalline, powder, soluble in alcohol, yielding a deeply red-coloured solution, on evaporation of which greenish crystals endowed with metallic lustre are obtained; these crystals proved to be the chloride of a base which, on analysis, was found to be composed of $C_{20}H_{21}N_3$. The eminent author proposes to investigate this subject more fully, for which reason the brief account here given may suffice for the present, the more so as the manufacture of this naphthaline red (first made at Bâsle, on the large scale) is as yet rather uncertain.

On Xylidine Red.—Dr. A. W. Hofmann.—When pure xylidine is treated with oxidising agents, no red-coloured pigment is obtained; neither is this the case when, after having been mixed with toluidine, xylidine is treated as is done for the preparation of rosaniline; but when xylidine is mixed with aniline, and then treated with the agents used to make rosaniline, a most beautiful carmine red pigment is obtained which dyes wool and silk a very fine colour. The probable composition of this pigment is $C_{22}H_{22}N_2,H_2O$.

Contribution to our Knowledge of Chrysaniline.—A. W. Hofmann.—When a solution of pure chrysaniline in pure wood-spirit (methyl-alcohol) is mixed with iodide of methyl, and heated in a sealed tube, for about six hours, to 100°, a solid crystalline substance is obtained, which, after having been purified, may be dissolved in boiling water, from which solution beautifully orange-carmine red crystals are deposited, which constitute the diiodhydrate of trimethyl-chrysaniline, $C_{20}H_{14}(CH_3)_3N_3,2HI$; the solution of this salt dyes wool and silk a deep orange-yellow, verging upon scarlet-red. From this substance, on being treated, when in solution, with ammonia, the monoiodhydrate of trimethyl-chrysaniline is obtained—

$$C_{20}H_{14}(CH_3)_3N_3,HI.$$

Trimethyl-chrysaniline yields, with acids, very well-defined salts, which are rather readily soluble in water, excepting the nitrate and picrate. Chrysaniline behaves with iodide of ethyl as it does with iodide of methyl.

Porphyritic Rocks of Austria.—M. G. Tschermak.—The Vienna correspondent of this Society, M. Ludwig, writes to the effect

that the author named at the heading of this paragraph has made a series of researches on augite and amphibole. The former mineral, if crystallised, is a combination of $MgCaSi_2O_6$ and the therewith isomorphous $FeCaSi_2O_6$. Augite, which is imbedded in rocks, contains alumina, and, moreover, a silicate made up according to the formula, $MgAl_2SiO_4$. The composition of amphibole is rather more complex, because it also contains a soda silicate.

On Benzylic Acid.—M. A. Jena.—When benzile is heated with an alcoholic solution of caustic potassa, benzylic acid is formed, and also benzoic acid. Benzylic acid is formed more readily when benzile is heated with water in sealed tubes. Pure benzylic acid fuses at 150°; moistened with concentrated sulphuric, it becomes red-coloured; heated for some length of time to 180°, it yields a red-coloured resin, and a compound, $C_{28}H_{22}O_5$. When benzylic acid is treated with dilute sulphuric acid and bichromate of potassa, water, carbonic acid, and benzophenon are formed—

$$\underbrace{C_{14}H_{12}O_3}_{\text{Benzylic acid.}} + O = H_2O + CO_2 + C_{13}H_{10}O.$$

Formation of Adipinic Acid from Mucic Acid.—M. L. Marquardt.—The author says—"Some time ago M. Bode succeeded in obtaining from the compound $C_6H_4Cl_2O_4$ (which compound is the result of the action of excess of phosphor-chloride upon mucic acid), by means of zinc or sodium-amalgam, a substance which he (M. Bode) called muconic acid, $C_6H_6O_4$; this acid only differs from adipinic acid by a deficiency of 2H. The author of this paper states that he has obtained, from muconic acid, pure adipinic acid, by treating the former, after having been moistened with water, with sodium-amalgam, and leaving this mixture standing for some hours in a warm place. The fluid, after having been removed from the mercury, is acidified with dilute SO_3, next shaken up with ether, and, on removal of that fluid, by distillation, adipinic acid remains behind.

Annalen der Chemie und Pharmacie, September, 1869.

This number opens with a series of three treatises on trimethyl benzol. The first of these papers treats on—

The Trimethylbenzol which is Formed by the Introduction of an Atom of Methyl into Xylol.—MM. R. Fittig and K. Laubinger.—In the introduction to this paper, the authors state that mesitylen is a peculiarly-modified trimethyl-benzol; and that the substance which, under the name of cumol, or pseudo-cumol, has been met with in coal-tar is also a modification of trimethyl-benzol, but different from mesitylen by its monobromide, $C_9H_{11}Br$, which is a crystalline substance, fusing at 73°. Pseudo-cumol has often been the subject of chemical researches; but the authors of this paper deny any value to these researches, since, according to them, pseudo-cumol, as applied to these researches and obtained from coal-tar, is and always remains, any rectifications and fractional distillations notwithstanding, a mixture of several hydrocarbons. The authors, therefore, have prepared pseudo-cumol synthetically, by introducing into xylol 1 atom of methyl. The fluid thus obtained was purified by distillation with sodium, and was found to boil constantly at 166°. *Products of substitution of pseudocumol.*—Mononitropseudocumol, $C_9H_{11}(NO_2)$, is a solid substance, crystallising in prisms, fusing at 71°, soluble in alcohol. It is distinguished from nitro-mesitylen by its point of fusion, and by its being soluble in cold fuming nitric acid without thereby undergoing any change. Dinitropseudocumol has not been obtained by the authors in pure state. Trinitropseudocumol, $C_9H_9(NO_2)_3$; also a solid substance fusing at 185°, and crystallising from its solution in benzol in large quadratic-shaped prisms. The authors then treat, under the following heads, the following subjects:—*Products of reduction from trinitropseudocumol; bromated products of substitution from pseudocumol; products of oxidation of pseudocumol.* Among the latter, xylylic acid, $C_9H_{10}O_2$, is found; also paraxylylic acid, and xylydinic acid, $C_8H_8O_4$, which are described at great length, as well as their salts.

The second treatise on this subject is headed—

On the Trimethylbenzol which is Generated when Two Atoms of Methyl are successively introduced into Toluol.—MM. Fittig and Jannasch.—The authors say they have proved, by researches made and published some time ago, that the methyltoluol prepared sythetically from toluol differs from xylol; a difference undoubtedly due to the unequal position of the atoms of methyl towards each other. The authors therefore argue that, if, synthetically, a third atom of methyl be added to the methyltoluol (dimethylbenzol), a trimethylbenzol, different from pseudocumol, will be obtained. In order to prove this hypothesis by experiment, they prepared from toluol a large quantity of methyltoluol; and, on treating that with bromine, obtained *monobromated methyltoluol*, $C_8H_8Br(CH_3)_2$, a liquid as clear and colourless as pure water, boiling at about from 204° to 206°. By means of iodide of methyl and sodium, trimethylbenzol was prepared from the liquid just alluded to. The result was the generation of a liquid boiling at 166°, and not differing in physical qualities from pseudocumol. In many of its chemical characters, this trimethylbenzol is not distinguished from pseudocumol. The greater part of this paper is devoted to a discussion of the relative position of atoms of CH towards other groups of polymers thereof; but since, without the introduction of some woodcuts annexed to the original, this rather abstruse subject cannot be clearly understood, we proceed to the third treatise:—

On the Trimethylbenzol contained in Coal-Tar.—MM. Fittig and Wackenroder.—The authors have prepared from the hydrocarbons of coal-tar (which have a high boiling point), by carefully-conducted, often-repeated, fractioned distillation, a hydrocarbon, the boiling point of which lay between 164° and 167°. This material has been converted into a trinitro-compound, which, after having been purified, yielded a solid crystalline body, fusing at 230°, soluble in alcohol, and yielding, after carefully-conducted elementary organic analysis, results leading to the formula $C_9H_9(NO_2)_3$. On dissolving this substance in warm benzol, the authors found that the body alluded to is not a simple compound, since the mother liquor of the solution in benzol yielded, on evaporation (after the previous separation of the crystalline compound just mentioned), a batch of prismatically-shaped crystals, entirely different from the needle-shaped body first obtained, which last crystalline body was found to fuse at 185°, and to possess all the properties of trinitropseudocumol. The researches of the authors, very exhaustively described, lead to the result that the trinitro-compound obtained from the hydrocarbon from coal-tar above alluded to is a mixture of trinitromesitylen and trinitropseudocumol; accordingly the hydrocarbon from coal-tar boiling at from 164° to 167° is a mixture of pseudocumol and mesitylen, which latter substance may even be prevalent in this fluid.

Electrolysis of Water in Contact with Silver.—Dr. Runspaden.—This monograph treats on the fact first observed by Prof. Wöhler—that when water acidified with sulphuric acid is decomposed by a galvanic current, and silver is applied as electrodes, peroxide of silver is deposited on the anode and metallic silver on the cathode. The two main questions answered by the author by a series of experiments are—What is the cause of the formation of peroxide of silver on the positive pole, and by what means does the metallic silver find its way from the positive to the negative pole? The treatise is too lengthy and too concisely abstracted already in this periodical [the treatise was published originally as a separate work] to admit of useful condensation. In an appendix, the author informs us that there is an error in all works treating on chemistry and physics, viz., the statement that gold (pure, of course) and platinum are the only two metals which are not oxidised at the positive pole when serving as electrodes. The author finds, and has confirmed by experiments carefully conducted, so as to exclude any source of error, that gold itself is oxidised to a very considerable extent, and that, during experiments as those alluded to, there is formed a definite oxide, $Au_2O_3,3H_2O$; percentically—gold, 79·47; oxygen, 9·62; water, 10·91.

On Chlorous Acid.—M. Brandau.—The author gives, in about twenty pages, a very complete and exhaustive treatise on the preparation and properties of chlorous acid, both as gas and as liquid. Since, however, the engravings added to this paper are absolutely required to understand a great part of it, we content ourselves by describing the properties of the liquid chlorous acid. It is a liquefied gas; colour of fluid, deep red-brown; very fluid. Even below 0°, the vapour of this liquid exerts a considerable pressure. Freshly prepared, the fluid boils about half a degree above 0°. If this fluid is suddenly brought to a temperature of about + 8° to 10°, it explodes with great violence. It cannot be kept without continuous and spontaneous decomposition for any length of time. The gas given off from this liquid exhibits the well-known greenish-yellow colour of chlorous acid. The specific gravity of the liquefied gas at 0°, referred to water at 4° (the point of greatest density of water), is 1·3298.

Preparation of Chlorate of Baryta.—M. Brandau.—The author makes a mixture of commercial sulphate of alumina, of sulphuric acid, water, and chlorate of potassa. The mixture should have the consistency of a thin magma, and be heated on a water-bath during half an hour, while it is frequently stirred up. The reaction which takes place is represented by the undermentioned formula:—

$$[Al_2(SO_4)_3] + SH_2O_4 + (ClKaO_3)_3 = [Al_2(SO_4)_3 + SKa_2O_4] + (ClHO_3)_2.$$

The product is a solution of hydrated chloric acid, alum, excess of sulphate of alumina, and excess of sulphuric acid. After the mixture has become quite cold, it is mixed with several times its bulk of alcohol, filtered, and washed with alcohol of 50 per cent. The alcoholic filtrate is neutralised with hydrate of baryta, whereby chlorate of baryta, sulphate of baryta, and some alumina are formed. The bulk of the alcohol is removed by evaporation. The aqueous solution of chlorate of baryta is next filtered, and the residue washed with water (distilled, of course). The liquid is next evaporated to crystallisation, yielding pure chlorate of baryta. A slight excess of sulphate of alumina and sulphuric acid should be applied, since, otherwise, some chlorate of potassa will remain mixed up with the chlorate of baryta.

The Brominated Products of Substitution of Dibenzyl.—Dr. Marquardt.—The author first refers to the researches made on this very same subject by MM. Fittig and Stelling, and then describes a series of identical compounds as those obtained by the parties just named, but prepared in a different manner. Chiefly the effect of a different temperature appears to be in play, in this instance, to produce compounds of different physical properties.

On some Products of Decomposition of Tribenzylamine.—M. W. Rohde.—This paper, being a critical review of M. Limpricht's labours on this subject, is not well suited for abstraction.

Determination of the Equivalent of Albumen.—M. Fuchs.—After briefly reviewing the researches made by Messrs. Schwarzenbach, Lieberkuhn, and others, on this subject, the author describes a series of his own experiments, the main result of which is that the precipitates formed by albuminous substances and platino-cyanide of potassium are substances of variable composition and decomposable by water. The author also found that the silver compound of albumen applied by M. Lieberkuhn for the determination of the albumen does not answer that purpose, since, on repeating, even up to seven times, the last-named author's experiments, he found the results to vary considerably, and, among themselves, to be different from those obtained by M. Lieberkuhn. On repeating M. Commaille's experiments on this subject, the author found that his very carefully-conducted experiments agreed with those of the last-named gentleman

very closely, and that, therefore, the compound obtained when chloride of platinum and a slightly acidified solution of albumen are mixed is the precipitate best suited for the determination of the equivalent of albumen.

Occurrence of Laurite in the Platinum Ore found in the Oregon Territory, U.S.—Prof. Wöhler.—Laurite is a mineral, first met with in the platinum ores found in Borneo, and composed of sulphide of ruthenium and sulphide of osmium. In the platinum ore here alluded to, this mineral is met with in such minute crystals that they are only distinguishable when magnified 50 diameters. Chemical tests, however, distinctly detected the laurite, which has been fully described some years ago by this eminent author.

Zeitschrift für Chemie von Beilstein, No. 15, 1869.

This number contains the following original papers:—

On Orthonitrodichlorophenol and an Isomeric Dichlorophenol.—M. O. Seifart.—Orthonitrodichlorophenol, $C_6H_2Cl_2NO_3OH$, is a solid substance, crystallising, from its ethereal solution, in rhombic-shaped crystals; soluble in ether, alcohol, and chloroform, but not in water; is not capable of being sublimed; fuses at 125°, but becomes decomposed at the same time. The author gives a catalogue of salts which this substance forms:—The ammonium salt, $C_6H_2Cl_2NO_3ONH_4+HO$, is a crystalline substance, readily soluble in hot water; orthoamidodichlorophenol is a solid substance, soluble in water, but far more readily in alcohol, and fuses at 166°; dichlorphenol, $C_6H_3Cl_2OH$, is a solid substance, difficultly soluble in water, readily soluble in alcohol and ether, fuses at 65°, and boils at 220°.

On Chloronitrophenols.—MM. Faust and Saame.—Chloronitrophenol, $C_6H_4Cl(NO_2)O$, is a solid body, exhibiting bright yellow-coloured, large sized crystals; it smells like saffron, fuses at 87°, is nearly insoluble in water, but readily soluble in alcohol and ether; it forms salts which crystallise, and are readily soluble in warm water. The authors give a lengthy catalogue (the name and formulæ) of a series of these salts, and distinguish α, β, and otherwise designated compounds, which, however, vary only in slight particulars from each other.

Decomposition of Acetate of Silver by Iodine at a High Temperature.—M. Birnbaum.—When a mixture of acetate of silver and iodine is submitted to heat, there ensues, at a comparatively low temperature, a very strong reaction, the products of which, partly vapours, and partly permanent gases, were, by suitable means, condensed and collected by the author. Among the condensable vapours, he found acetate of methylic ethyl, boiling at 55°, and hydrate of acetic acid. Among the gases, carbonic acid, acetylen, and, beside this, another carburetted hydrogen were found. The solid residue of the reaction consisted of iodide of silver and some carbonaceous matter. The author enters into a very lengthy discussion as to the origin of the different substances found, but we cannot follow him therein, since it would require the reproduction of an enormous series of formulæ. When acetate of silver is heated by itself, a very violent reaction ensues, which sometimes even comes to actual combustion. The reaction yields acetic acid, and, among the gaseous products, CO_2 and marsh gas. The residue in the retort was found to consist of metallic silver and carbon.

Definition of the Place to be Assigned to the Benzol Series.—M. V. von Richter.—A paper not suited for abstraction.

New Method of Formation of Ortho-Chlorobenzoic Acid.—M. Wroblevsky.—When sulpho-diazo-chlorotoluol is boiled with anhydrous alcohol, there is formed ortho-chlorotoluol, $O.C_6H_4Cl.CH_3$, a fluid boiling at 156°, and which, on being treated with chromic acid, yields ortho-chlorobenzoic acid, a solid substance, difficultly soluble in water, but readily so in alcohol, and fusing at 151°.

Behaviour of Toluidine towards Bromine.—W. Wroblevsky.—When, into an alcoholic solution of toluidine, a mixture of air and vapours of bromine are passed, a large quantity of dibromotoluidine, and only very little monobromotoluidine, is formed; the former precipitates, and is collected on a filter. After addition of water to the alcoholic solution, the filtrate is evaporated, and until after having ceased to give off acid vapours. Ammonia is then added, in order to precipitate monobromotoluidine. Dibromotoluidine—

$$C_6H_2Br_2(NH_2).CH_3,$$

is a solid body, crystalline, fusing at 73°, soluble in alcohol and ether, not in water.

On Ethyl-Phenol.—MM. Beilstein and Kuhlberg.—The authors state, first, that it is just possible that tyrosin may be equal to amidoethyl-para-oxybenzoic acid, $C_9H_{11}NO_3$, and they tried to obtain it (tyrosin) from ethyl-para-oxybenzoic acid, which latter acid may be made by acting upon ethyl-phenol with sodium and carbonic acid. The researches made by the authors, and described in this paper, are, as might be expected, of a very complex nature, their aim being the synthesis of tyrosin. We regret that the paper is not suited for further abstraction.

Moniteur Scientifique, No. 305, September 1, 1869.

This number contains, as usual, a series of very well written papers, but those which are original do not belong to the domain of chemistry. Among the *brévets d'invention*, we briefly notice that MM. Broenner and Gutzkow have obtained, in France, a patent for the manufacture of anthracen, by distilling the asphalte, employed for making street pavements, with super-heated steam, and a subsequent sublimation of the raw product obtained. The anthracen is converted into anthraquinon, by gently heating the former with twice its weight of nitric acid, sp. gr. 1·3 to 1·5, and washing with water the product obtained. The anthraquinon is converted into alizarine and purpurine (both are formed at the same time), by dissolving it in gently heated sulphuric acid, to which solution nitrate of protoxide of mercury is added. The material resulting from this reaction is dissolved in an alkali, filtered, and next precipitated by an acid, whereby variable quantities of alizarine and purpurine are obtained. This process of manufacture is already carried out, on the large scale, by MM. Meister, Lucius, and Co., at Hoechst, near Frankfort-on-the-Maine, and is a great improvement upon MM. Græbe and Liebermann's method. The editor of the French paper above named states that he received from the manufacturers just named a sample of a ¼ of a kilo. of this artificially-prepared alizarine.

No. 306, September 15, 1869.

This number contains only the following original communication:—

A Letter from MM. Meister, Lucius, and Co., at Hoechst, near Frankfort-on-the-Maine (dated September 10th last), wherein these parties state that they are not manufacturing artificial alizarine by the method for which MM. Broenner and Gutzkow have taken a French patent. They also desire it to be understood that, for some time already, they have manufactured a substance which they call *alizapurine*, by a process kept secret. M. Camille-Kœchlin, of Mulhouse, after having very carefully tested a sample of the substance made by the manufacturers above-named, states:—"The sample sent, though it is not truly an alizarine in the strictest sense, since it differs, in many respects, from genuine alizarine, as obtained from madder, or as that lately produced by artificial means, yields, however, in its application, colours superior to those obtained from madder and any of its commercially made products; and no doubt the material made by MM. Meister and Lucius will be the madder of the future." M. Kœchlin adds—"The paste, for in that state it is obtained, I experimented with has fully five times the tinctorial power of madder, and all the colours are more brilliant.

The other papers contained in this number are not original, and, excepting the *brévets d'inventions*, are already either published by us in full—as, for instance, Mr. Abel's paper on explosive substances—or have been abstracted by us from the original publications in which they appeared.

Revue Hebdomadaire de Chimie, September 9, 1869.

Apparatus for the Liquefaction of Protoxide of Nitrogen and other Gases.—M. Deleuil.—The apparatus, of which an excellent woodcut is given, is an improvement upon the very generally used and well-known apparatus of M. Natterer, of Vienna, and, in principle, the same—viz., a force-pump, to the piston of which an upwards and downwards movement is imparted by means of cranks and wheelwork. The recipient for the condensed gas, and the body of the pump, are surrounded by a strong freezing mixture, and the recipient is provided with properly constructed valves, whereby it is possible to make, with ease and comfort, and without danger, experiments with liquefied gases in a lecture-room; while the apparatus for condensing the gases is placed in a separate room by itself. Without reproducing the cut, we cannot enter into more details on this subject. The price of the apparatus complete is, at Paris, 1900 francs (£76).

Annales de Chimie et de Physique, August, 1869.

This number contains only one original paper, or, rather, a lengthy essay, on—

Interrupted Currents.—M. A. Cazin.—This essay is strictly of a mathematico-physical nature, and not suited for abstraction.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 140, August 15, 1869.

This number does not contain any original paper relating to chemistry or allied sciences.

TO CORRESPONDENTS.

J. Cox.—The subject of your query has already been fully discussed in these columns.

W. H. Hindmarsh.—We know of no analytical practice for disposal just now, or of a partnership in chemical works. By repeating the advertisement, you would probably hear of one. A Mr. G. Green, of 5, Sebbon Street, Islington, has written to us for your address, as he wishes to have his certificate returned.

W. R.—Chloride of iron can only be economically prepared on the large scale at chemical works, where hydrochloric acid can be had at a mere nominal cost. Your other questions can be better answered by a few practical experiments, than by written descriptions. The last of Dr. Angus Smith's articles, "On the Examination of Water for Organic Matter," appeared in No. 510.

Biggs, Holland, and Biggs.—We do not know the address of MM. Græbe and Liebermann, but a letter to the care of the publishers of the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin* will probably reach them.

THE CHEMICAL NEWS.

VOL. XX. No. 516.

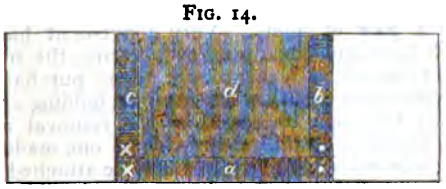
ON MICROSCOPICAL MANIPULATION.

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 171.)

A VERY useful trough for viewing objects in fluid can be made with a slight amount of trouble. Cut in half an ordinary 3 × 1 slide (Fig. 14, shaded portion in centre). From this cut off the strip *a*, then the pieces *b* and *c*, and reject the centre piece, *d*. Before cutting, it is well to mark the adjacent edges with ink, as indicated in the figure, to prevent any mistake in putting them together afterwards. The three pieces *a*, *b*, and *c* are to be cemented with marine glue on the middle of a slide, and, as the cut portions, if replaced as directed, fit each other accurately, there is no occasion for grinding. The trough is completed by fastening an oblong piece of thin cover-

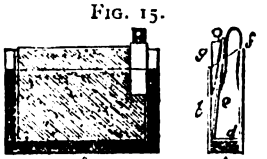
FIG. 14.



glass on the upper surface. For this purpose it is better not to use marine glue, as the cover frequently requires removal, as, from its thinness, it is liable to be broken in cleaning. It can be best secured by the use of the following, known as "electrical cement," from its having been used to fasten various portions of electrical apparatus together:—Melt together five parts rosin, one part bees'-wax, one part red-ochre, two parts Canada balsam; mix well, and pour into pill-boxes of convenient size. This cement is most conveniently used with a miniature soldering bit, which is rendered more comfortable to use by its being balanced with a plug of lead in the handle. With a little practice, a very neat joint can be made. The cement is also useful for many other purposes, of which notice will be taken in the proper place.

Larger troughs, having sides of plate-glass, can be made by those who will take the necessary trouble. In this case, the surfaces to be cemented must be

FIG. 15.



accurately ground. Such vessels are very useful in looking over the results of pond-hunting with a low power for the purpose of selecting such objects as may be required for more detailed observation. The troughs, of various shapes, can be purchased at most opticians.

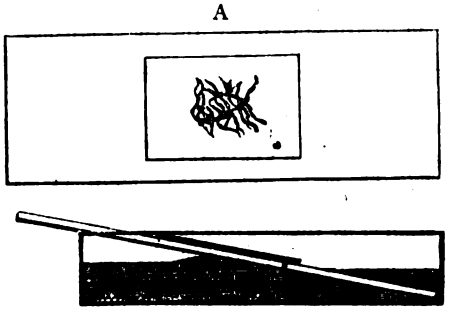
The form represented in Fig. 15 is particularly convenient, as by means of the whalebone spring, *f*, and the wedge, *g*, the space between the front glass, *b*, of the trough and the inclined plate, *c*, is capable of adjustment, so that an object can, when desired, be kept close to the front glass. These parts can be removed when a greater depth of water is required for larger objects.

A simple and useful contrivance, to be used as a growing-slide, has been described by Mr. C. J. Muller (*Monthly Microscopical Journal*, vol i., p. 174). The object of a growing-slide is to keep alive any minute water-plant or animal, the development of which it is wished to observe. Many plans have been devised for this purpose, but none equal in simplicity or efficiency that now to be described.

An ordinary 3 × 1 slide (Fig. 16, A) is pierced with a minute hole at about 3-10ths of an inch from the centre on one side. When an object under investigation is put upon it immersed in water, the thin glass cover is so placed as to include this hole, which should be near its margin. When it is desired to keep the specimen moist while off the stage of the microscope, the slide is placed in a small flat trough (B) in an oblique position, object uppermost, with one

FIG. 16.

A



B

end (that nearest the hole) resting against the bottom of the vessel on one side, and the other resting upon the edge of it. Sufficient water is put into the vessel to admit of the liquid reaching within a ¼ or ½ an inch of the glass cover on the uppermost side, when it will be found that the water on the under side reaches beyond the centre of the slide, and consequently beyond the hole with which it is pierced. In this state, the object will remain moist so long as the trough contains a sufficient quantity of water. When required to be placed on the stage of the microscope, the water is easily wiped off the slide, without any disturbance of the object.

Mr. Muller's original trough was made of tin-plate, but, as this material is liable to rust when long in use, Mr. F. W. Gay has had them made of pewter of an improved form, which has proved an effectual remedy for this defect. Thus constructed, they are to be obtained of Mr. C. Baker, Holborn.

The process of attaching cells to plates of glass has been given; but nothing has been said about the material of the rings forming the cells. When required of some considerable depth, rings made of slices cut from thick glass tubing answer admirably. If square or oblong cells are required, they can be

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

cut from tubes of suitable form. Very useful cells are now made by Mr. Collins of pure tin of various thicknesses, from that of thin writing-paper up to that of a thick tube cell: several sizes can also be procured in each thickness. Tin is not acted upon by any of the fluids used in preserving microscopical objects, and has the advantage of being much cheaper than glass, and at the same time equally efficient. Cells of unusual form can readily be cut from the sheet-tin with a penknife or pair of scissors, and circles can readily be punched. The adhesion of the cover-glass is improved, and the process of mounting in fluid much facilitated, by grinding the upper surface of the cell after it is attached to the slide with water upon a Water-of-Ayr stone, as suggested by Dr. Carpenter. This gives a beautiful surface, and ensures the perfect fit of the cover, and renders the closing of the cell a matter of greater certainty than it would be if the natural surface of the metal were used.

Some very useful aids to the examination of microscopical objects, and which can readily be made by the exercise of the smallest amount of mechanical ingenuity, are described by Mr. S. J. McIntire, in the *Transactions of the Quekett Microscopical Club*, vol. i., p. 69. One of these is of such general application that it will be well to describe it. A piece of sound sheet cork, about 2 in. by 3¼, or other convenient size, and of a thickness suited to the purpose for which it is intended, is perforated with an oval or circular hole; this may easily be cut with a penknife or sharp chisel, and the edges finished with a file. The cork is placed between two pieces of glass of similar size, the lower one being covered with a few layers of pink blotting paper, and the whole contrivance kept together with two india-rubber rings. The cell so constructed is used for keeping alive small insects that inhabit damp situations, such as *Podurœ*. The moisture is readily supplied by dipping the end of the slide into water, which is absorbed and retained by the blotting paper. The proper food of the insects can be placed in the cell. By the aid of this simple contrivance, Mr. McIntire has been enabled to make some most interesting observations on the habits of the *Podurœ*, which have been kept living in these cells for many months. This plan admits of modification to suit the object under observation. In the author's researches on the blow-fly, it was necessary to use thin glass, and to have the means of viewing the object on either side; this was accomplished by cutting a rectangular hole in a suitable piece of cork, placing the thin glass on either side, and securing it by bending on its edges strips of the sheet tin used for making cells which had been inserted in the cork, which effectually fastened the glass in a somewhat similar manner to that by which a stone is set by jewellers, and readily permitted its removal when required.

Among the tools employed by the microscopist, none are more generally in request than needles of various sizes and forms. They are frequently required of various curvatures; this bending can readily be performed by the microscopist himself. If a needle is heated to redness in the flame of a spirit-lamp, and allowed to cool, it can easily be bent or twisted into any required form. Steel so treated, if heated again to redness and suddenly cooled in water, becomes excessively hard and brittle; in this condition, it is capable of scratching glass, but is too fragile for dissecting instruments. The right temper for the dissecting needles is obtained by heating and cooling in tallow or oil; this, with needles, may be readily done in a common tallow (not composite or paraffin) candle. While the needle is soft, it may, by the exercise of a little dexterity, be hammered out so as to form a small knife, or lancet, which can then be hardened so as to take a cutting edge; many useful instruments can also be made out of small pieces of steel. Needles and cutting instruments are best sharpened upon a very hard, white stone, known at the tool shops as Arkansas oil-stone; it cuts very rapidly, and gives an extremely fine edge. Scissors, when blunt, may readily be sharpened on the oil-stone, by opening the blades and rubbing them on the stone, holding them nearly upright. The burr produced by this operation need not be ground off, as it is soon removed when the blades are worked together; the screw is to be tightened if required. For delicate dissections, the steadiest cutting instrument is a kind of scissors, made almost exactly like a minute pair of sheep shears, and known as the microtome; in use, it feels very much as if the fingers were extended and armed with cutting edges. There is hardly any other cutting instrument so much under the control of the operator.

The best handles for needles and other small instruments are made of cedar pen-holders into which the needle, with the eye broken of, is inserted with a pair of pliers. Very convenient handles, which have the advantage of allowing the needles to be removed at pleasure, are to be purchased at fancy warehouses; they are used for holding crochet hooks; they are improved by the removal of the ivory handle, and the substitution of one made of a cedar pen-holder, which can easily be attached to the metal socket with electrical cement, and will be found to be lighter and more pleasant in use.

(To be continued.)

A NEW AND ECONOMICAL METHOD FOR EFFECTING THE EXTRICATION AND CONDENSATION OF AMMONIA FROM GAS LIQUOR

FOR PURPOSES OF CHEAP CARRIAGE, AND FOR FACILITATING THE MANUFACTURE OF AMMONIACAL SALTS.*

By FREDERICK BRABY, F.G.S.

It is but a very few years since that the various bye-products obtained from the manufacture of coal gas were not merely a drug in the market, but proved an absolute nuisance to the manufacturer and to the general public.

Coal tar was even burnt under the retorts, or was introduced therein for the production of gas; and gas liquor was commonly given away to anyone whose ingenuity might enable him to turn it to a useful purpose.

But the progress of science in this, as in other cases, soon discovered applications where none were supposed to exist.

From coal tar are not only now obtained naphtha, benzol, carbolic acid, and other valuable derivatives, but also the brilliant and diversified colours of what are called aniline dyes are obtained from the same source. The ammoniacal liquor, too, to which, on the present occasion, I desire to be favoured with your attention, is now not only not given away in the Metropolitan and other districts, but, in certain localities, the greatest competition exists for its acquisition. It at present constitutes, in this country,

* Read before the British Association, Exeter meeting, Section B.

the principal source of ammonia, and, consequently, of the ammoniacal salts, which are so usefully and so successfully applied in the arts, and more especially to agriculture. In London and its neighbourhood, the purchase of the residuary products of the various gas companies is eagerly sought after, and it is now considered a privilege to be allowed permission to tender for them for the term of one, two, or more years, supply. Practically, the tar and gas liquor trade is in the hands of a few parties jealously desiring to exclude outsiders, who thus find it extremely difficult and often absolutely impossible to obtain even a few thousand gallons.

The object of the present communication is to show how the demand for gas liquor which so far exceeds the means of actual supply can be met. It is to show, moreover, that by condensation and reduction of bulk for transport, small and remote gas works may be enabled to utilise and export their residual products at a profit; and above all, how, by the introduction of certain improvements, the quantity of ammonia as produced and utilised from the manufacture of gas, may be practically increased from ten to fiftyfold.

The strength of gas liquor is commonly specified in the various tenders as technically 6 oz. The prefix, denoting the number of ounces, refers to each gallon of the liquor, and does not signify the number of ounces of ammonia that are present, but the number of ounces of sulphuric acid which would be required to neutralise the ammonia. Consequently a butt of 108 gallons of 6-oz. liquor implies, by calculation, that 108 times 6 ozs. or 40 lbs. of sulphuric acid are required to saturate the whole quantity. Now it is found in practice that, if we divide the quantity of sulphuric acid required by 3, we shall get at the quantity of ammonia actually present. This result closely agrees with theory, the equivalent of dry ammonia being 17, and that of monohydrated sulphuric acid (oil of vitriol) being 49; the proportion is very nearly 1 to 3, It follows, therefore, that, as 40 lbs. of sulphuric acid are required to saturate a butt of 6-oz. liquor, so one-third of this or little more than 13 lbs. of real ammonia are contained in this immense quantity of liquid and merchantable product, weighing as it does in the aggregate no less than 1107 lbs., or half a ton. On referring to the ordinary commercial standard, viz., of 6 ozs. to the gallon, 6 ozs. of sulphuric acid divided by 3 gives 2 ozs. of ammonia as the entire quantity present. Now a gallon of the gas liquor weighs 10 lbs. and, if the lbs. be multiplied by 16 to reduce them to ounces, we have a total of 160 ozs., containing only 2 ozs. of real ammonia or 1 oz. to 80 ozs. of water.

The result of this is, practically, to prohibit the transport of gas liquor over any but moderate distances, because, in its present form, for every ton of real ammonia carried by barge, tank-cart, or otherwise, no less than 80 tons of water must be carried for no other purpose but as a solvent. It must not be inferred, however, that the *whole* of these 80 tons of water is waste carriage. Ammonia in a free state cannot be conveniently carried, except when dissolved in a certain quantity of water. It would not be judicious to concentrate the ammonia to a higher degree than 0·900, since if, in course of carriage, it were subjected to any great degree of heat, the water at an elevated temperature would disengage some of the NH_3 held in solution, and such a disengagement of ammonia might be attended with dangerous results. A very useful and safe solution for all purposes of transit would be about one part by weight of ammonia to four parts of water; this would reduce the present cost of carriage for this important article to no less than twenty times, or, in other words, the transit of a certain quantity of ammonia over a certain distance costing now £20 would, if conveyed in the above concentrated form, be reduced to 20s. This scale of reduction would at once enable it to be carried by rail in petroleum or other barrels, or in tank-trucks, or otherwise, and would bring the numerous gas works which are scattered over the United Kingdom within economical transport of the centres of manufacturing industry, so that this important bye-product of gas-making might be utilised for the general good, and be not so extensively wasted as has been, and is now, frequently the case.

In order to effect this desirable object, I recently, in conjunction with Mr. Baggs, secured a patent for effecting the necessary concentration of ammonia by certain novel means, which promise in practice to prove far more rapid and economical than any hitherto employed. The process may be shortly described as follows:—To the common ammoniacal gas liquor a certain quantity of slaked lime is added. The liquor thus treated is placed in a capacious boiler or still containing from four to five thousand gallons. The whole is then heated and maintained at a temperature of from 100° to 200° F., the liquor being slowly but constantly stirred by means of an internal agitator, the spindle of which passes through a stuffing box in the end of the boiler. A powerful blast of air from a double-action force-pump actuated by a small steam-engine or otherwise, is blown continuously through the liquor. The air enters by two long perforated pipes placed near the bottom of the boiler, and in its upward passage it is compelled to pass through a horizontal diaphragm drilled with numerous small holes. The result of this arrangement being that the air, in its ascent, is subdivided into innumerable small sheaves and bubbles, to each and all of which, in accordance with well-known and recognised laws, the ammonia attaches itself and is carried away with only a very small proportion of aqueous vapour. An exit pipe is fixed to the top of the boiler, so as to carry away the mixture of air and ammonia, and the extremity of this pipe dips into a supply of water contained in a cold and suitable receiver, where the ammonia is immediately absorbed, and the air after thus effecting its removal in a separate state, escapes through the water and is permitted to pass off into the atmosphere. The condensers are generally arranged like a series of what are known as Woulfe's bottles, but for the purpose of obtaining great strength and purity, this arrangement may be superseded in the manner following.

The ammoniacal gas separated by the air is purified in a manner which will be afterwards described, and is then caused to pass into a vessel about three parts filled with broken lumps of pure block ice. From the well-known affinity of ammoniacal gas for cold water, the gas is arrested by the ice, which is rapidly liquefied, and a pure solution of ammonia of any required strength is obtained. It is advantageous to cool down the mixture of air and ammoniacal gas before it is allowed to enter the condenser; the air after having parted with the ammonia which has been dissolved by the liquefied ice, passes off into the atmosphere as in the former instance. The finest Norwegian transparent block-ice may, in the height of summer, be obtained at the London Docks at 23s. per ton, and even less, according to the number of tons required, the supply being constantly maintained by the arrival of fresh ships. Or ice may be obtained by one of Siebe's refrigerating machines almost as cheaply as that which is imported.

This patent process for separating the ammonia by blowing air through gas liquor, when at an elevated temperature, is so much more rapid in the operation than the process of merely boiling the gas liquor as hitherto conducted that, with a very moderate-sized apparatus, several thousand gallons of gas liquor can be treated in a single day, and the ammoniacal produce of the largest works may be continuously converted into a concentrated and more portable form without trouble or delay. Even in the smallest works, consuming not more than from ten to fifty tons of coal a week, the bulk and weight of the gas liquor may be quickly reduced, and the result will be of such standard value that a still containing from 20 to 100 gallons would, probably, in such cases, answer every desired purpose, and would be found to be remunerative. In many instances the gas liquor might be heated and the power supplied, if desirable, from the waste heat of the retorts.

By the adoption of this improved process the present trade in crude ammonia may be expected to expand and to become of higher importance than it now is.

The comparatively limited supply which is now available restricts its application. The commercial advantages which would be derived from the many technical purposes to which it is applicable would be considerable, and manufacturers being enabled to obtain cheap supplies from distant sources, the total quantity utilised would be immensely increased.

When, instead of producing caustic ammonia it is desired to manufacture ammoniacal salts, the ammoniacal gas in conjunction with the atmospheric air may be conducted into sulphuric or muriatic acid, or into a metallic or saline solution capable of appropriating the ammonia.

As the evaporative power of air increases with the absence of moisture therein, it is possible that, by drying the same artificially before introducing it into the liquor, it would take up a great quantity of ammonia. The removal of all moisture from air may be effected with comparatively little expense by the suction of the air required for the force-pump through sulphuric acid, and a close wooden box containing lumps of chalk. This method is well known in connection with other applications.

The blast of air may be hot or cold, and may be delivered in any manner adapted to increase and effect more intimate contact between the air and the liquid containing the ammonia.

By adopting what I call the atmospheric or blowing principle, nearly the whole of the ammonia can be liberated from the solution in which it is contained, without any fire or external heat applied to or under the still or boiler, but, if the liquor be heated, the solubility of the alkaline gas is diminished and its extraction is facilitated.

Gas liquor is, in this country, the most common, and at the same time the most economical, source of ammonia, and the system of extraction by forcing air would, of course, be equally applicable to ammoniacal bone liquor, or to any other chemical preparation in which the caustic ammonia is held in solution.

(To be continued).

NOTE ON THE EARLIER HISTORY OF THE SCIENCE OF HEAT.

By GEORGE FARRER RODWELL, F.C.S.

As a supplement to the lectures on "Heat" which have recently appeared in this journal, it will not, I think, be out of place to give a short account of some of the principal facts connected with the earlier history of the science of Heat. In doing this it will be impossible to preserve any great continuity, my object being rather to indicate some of the old scientific treatises in which experiments are detailed, and to supply the student with a means of reference which the foregoing lectures of necessity could not afford. The memoirs and the works of recent writers on Heat are so well known and so much at the command of all who desire to pursue the study, that it will be sufficient to mention the names only of Cazin, Clausius, Despretz, Franz, Guthrie, Helmholtz, Herschell, Hirn, Joule, Knoblauch, Kopp, Magnus, Mayer, Melloni, Pouillet, Regnault, Balfour Stewart, Tait, Thomson, Tyndall, and Wiedemann.

It is difficult to say when the science of Heat, properly so-called, first arose. It is certainly a younger science than Statics, Dynamics, Hydrostatics, Hydrodynamics. Pneumatics, Optics, Static Electricity, and Magnetism. I question whether Acoustics can be added to this list, although it has ever had the stimulating effect of the art of music, which, in its turn, had the stimulating effect of Church Ceremonial, and attained some perfection in the 16th century, and much perfection in the 18th. M. Libri very truly says "Les recherches des Pythagoriciens sur les vibrations des corps sont les plus anciennes expériences de physique qui soient parvenues jusqu'à nous,"* but we must bear in mind that the results of these experiments were applied to music as an art, rather than to sound as a science. Omitting, then, the question of the precedence of Acoustics, we yet perceive that Heat is amoung the younger of the sciences. This arises from the fact that, until late in the last century, heat was regarded as a chemical agent, and became merged more or less into chemistry proper. Separate treatises on Heat were unknown, but every chemical work devoted some chapters to the acts and operations of fire, "Car en effet," as Lemery remarks, "c'est par le moyen du feu qu'on vient à bout de presque toutes les opérations chimiques." Hence arose such expressions as "Chymick heat," "ye hete of ye chimists fornace," &c., to designate intense degrees of heat. Then, again, the theory of Phlogiston is essentially a heat theory in one sense, but it has ever been regarded as a chemical theory, because the action of heat is so closely associated with the majority of chemical operations that the scientific cared not to step aside to examine the nature of heat itself, preferring to leave the examination of the cause to study that of the ultimate effect. Boerhaave in his admirable *Elementa Chemiæ*, the most extensive chemical work which had up to that time (1732) appeared, devotes a good deal of space to the "instruments" of chemistry, "beginning," as he remarks, "with fire, by reason that no chemical operation ever was, or can be hereafter performed, to which fire does not contribute." (It may be remarked here that *fire* and *heat* were often used as almost synonymous terms by old writers; thus Boerhaave says "Fire expands even the hardest bodies.") I imagine that Francis Bacon's little treatise, *De Formâ Calidi*, was the first attempt to raise Heat into a separate science. It was an utter failure, yet the attempt is to be applauded, for it was the lack of observation and the paucity and obscurity of the knowledge possessed at that time by the world at large in regard to heat, that of necessity resulted in the failure. What are we to say to such an assertion as the following? "Omnino calor cælestium augetur tribus modis; videlicet ex perpendiculo, ex propinquitate sive perigæo, et ex conjunctione sive consortio stellarum." S'Gravesande in his excellent *Physices Elementa Mathematica*—one of the best illustrated works on Physics which has ever appeared, and which may even now be consulted with advantage,—gives 45 pages ("Editio tertia, duplo auctior," 1742) to heat, and 234 to light. He commences the "Liber de igne" with the very pertinent remark in his blunt rugged Latinity, "Pauca de igne norunt philosophi; multa ipsos latent," adding very sensibly (and it is to be wished that his example were more often followed) "Hypotheses non fingam; generaliora, quæ experimentis deduci posse mihi videntur, eo quo potero meliore ordine, dicam."

The production of fire by the refraction and reflection of the rays of the sun was well known to the ancients. The sacred fire of Vesta was re-kindled by the rays of the sun reflected from a metallic mirror, and, according to Pliny, the mirror was sometimes replaced by a glass globe filled with water. Aristophanes clearly alludes to the use of glass lenses as burning glasses in the Νεφελαι.

Lactantius, in his curious treatise, *De ira Dei*, mentions that a glass globe filled with water and placed in the rays of the sun, will kindle fire even in the coldest weather.† Baptista Porta in his ever new, ever interesting treatise, *Magiæ Naturalis*—which links the magic of Art of Eastern

* "Histoire des Sciences Mathématiques en Italie." 1838.

† Lactantius was born about A.D. 250; he died in 326. His works were amongst the first printed in Italy; the first edition issued from the press of the monastery of Subiaco as early as the year 1465, while a second issue appeared in Rome in 1468, in both cases it will be remembered before a single book had been printed in this Island. The passage alluded to above is taken from the tenth chapter, entitled "De mundi ortu, et rerum naturæ, et Dei providentia," and is as follows—"Omitto silicem, ac ferrum. Orbem vitreum plenum aquæ si tenueris in sole, de lumine, quod ab aqua refulget, ignis accenditur etiam in durissimo frigore."

civilisation with the magic of Nature of Western civilisation, Chaldæan mysticism and Theurgy with the Realism of the Renaissance,—Baptista Porta mentions the fact that heat, sound, and cold may be reflected by mirrors in the same manner that light is reflected. As a delicate instrument of observation in the case of the reflected cold, Porta placed his eye in the focus of the mirror, as, some two and a half centuries later, Dr. Tyndall placed his eye in a focus of dark heat rays in order to see whether any light accompanied the heat rays. Porta's account is interesting; it occurs in the seventeenth book, and is entitled "Calorem, frigus, et vocem speculo concavo reflectere." "Si quis candela in loco," he continues, "ubi spectabilis res locari debet apposuerit, accedet candela per aerem usque ad oculos, et illos calore et lumine offendet, hoc autem mirabilius erit, ut calor, ita frigus reflectitur, si eo loco nix objiciatur, si oculum tetigerit, quia sensibilis etiam frigus percipiet." Somewhat later Hamerus Poppius calcined antimony "per radios solares" with the use of a lens, in order to determine whence came the gain of weight. Bonaventure Cavalieri, the discoverer of infinitesimals, writing in 1632, states that he was able to inflame dry substances by reflecting the heat emitted by a charcoal fire by means of a spherical speculum; by using a parabolic reflector he produced the same effect at a distance of 5 feet, a small fire of wood being the source of heat. He recommends a hyperbolic reflector, and asserts that the impressions of heat, cold, sound, and scent move in straight lines.* Athanasius Kircher has also treated of reflection in his *Ars Magna Lucis et Umbræ*.

The term "radiant heat" was introduced by Scheele in his treatise entitled *Luft und Feuer*. Pictet in his celebrated *Essais Physiques sur le Feu* (1790) demonstrated the enormous velocity of propagation of radiant heat; he also treats of the absorption and reflection of heat, and of latent and specific heat. Prevost made known his "Theory of Exchanges" in 1791 through the medium of the *Journal de Physique*.

Black discovered "latent heat" about the year 1760; his pupil Irvine introduced the term "capacity for heat," while Gadolin replaced it in 1784 by the term "specific heat." In connection with the determination of the specific heats of various substances, the following names are most prominent:—Wilke, Lavoisier, Laplace, Kirwan, Dalton, Dulong, Petit, De la Rive, Regnault, Favre, Silbermann, Bérard, De la Prevostaye, and Desains.

As regards the air thermometer I am inclined to think that Galileo invented it about the year 1597; some attribute it to Sanctorio of Padua, others to Cornelius Drebbel of Alcmaer, while others, again, maintain that it was discovered by each of these men independently of each other. Some of the members of the Accademia de Cimento first constructed a fluid thermometer in 1655 or 1656. Edmund Halley introduced mercury in the place of alcohol. Otto von Guericke was the first to take the freezing of water as the lowest limit of the scale, while Renaldini, in 1694, proposed the boiling and the freezing points of water as the opposite limits of the thermometric scale. A kind of rude differential air thermometer is mentioned by Sturmius in his *Collegium Experimentale sive Curiosum* (1676). Sir John Leslie described the differential air thermometer which bears his name, in 1804 in his "Experimental Enquiry into the Nature and Propagation of Heat."

Leslie's principal work is his "Essay on Heat" in which he described the radiative and absorptive power of various substances, and determined the laws which regulate the radiation of heat. He maintained, however, that air is as essential to radiation as it is to convection.

The subject of the conduction of heat was discussed at some length by Lambert in his "Pyrometrie" published in 1779, but the earlier mathematical treatment of the subject is due to Fourier, and is detailed in a paper entitled "Thèorie Analytique de la Chaleur," communicated to the Academie des Sciences in 1807. His definition of conductivity is extremely lucid, and he has treated of the cooling of an uniformly heated sphere with great ingenuity and elaboration. Poisson and Carnot have also applied the higher mathematics to the elucidation of various questions connected with the science of heat, and in our day Helmholtz, Clausius, and Thomson.

Mariotte and Hooke observed that glass cuts off many of the rays of radiant heat. M. De la Roche discovered in 1812 that radiant heat which has passed through glass has lost the rays which glass most readily intercepts, and that, as the temperature of the radiating source rises, so does the readiness of the radiant heat to pass through glass increase. Nobili and Melloni worked together on the subject of radiant heat. The former invented the thermopile, while the latter made the important discovery that rock-salt is very transparent to all kinds of heat, and that, by using lenses and prisms of rock-salt, dark heat rays may be refracted exactly in the same manner that light is refracted by glass. These results were published in the celebrated treatise entitled "La Thermochrose, ou la Coloration Calorifique," and were at first received with some credulity by the Parisian *savans*.

The most notable experiments in connection with the polarisation of heat were made by Bérard in 1812 (*Memoires d'Arcueil*, vol. 3), and later by Forbes.

The Abbé Rochon endeavoured to determine the comparative heating effects of the various coloured rays of the spectrum as early as the year 1776; he employed a flint-glass prism and an air thermometer, and reckoned the heating power of the red rays to be about eight times greater than that of the violet. In 1798 Leslie (?), by using a differential air thermometer, found the calorific energies of blue, green, yellow, and red to be as 1 : 4 : 9 : and 16. In 1800, Sir William Herschell employed a small mercurial thermometer for the same purpose, and arrived at the conclusion that the hottest part of the spectrum is beyond the red rays. A detail account of recent research on this subject (specially of the "long spectrum of the electric light") will be found in Tyndall's work "On Heat treated as a Mode of Motion."

The history of heat theories has not been alluded to above because the history of the kinetic theory was discussed at some length in the first of the foregoing lectures,* and I have elsewhere† treated of one of the phases of the material theory. Bergman's *De Materia Caloris* may also be consulted by those who are interested in this part of the subject. Of recent works on Heat I would specially mention Clausius "On the Mechanical Theory of Heat;" the treatise of Tait "On Thermodynamics;" the *Thèorie De la Chaleur* of M. Desains, and the *Thermodynamique*, of M. Bertin ‡

It is hoped that the above facts—desultory though they be—may be of interest to those who desire to follow the literature of the science of Heat in greater detail than is possible in lectures, which are rather for purposes of demonstration than for the discussion of facts connected with the history of a science.

International Exhibition of Amsterdam.—Professor Pepper is now giving an instructive lecture at the Royal Polytechnic on the "Tentoonstelling." While speaking highly of the inhabitants, the lecturer refers at length to their industrial pursuits, and illustrates the lecture with enlarged views of the Exhibition as well as some curious costumes worn by the Netherlanders. The lecture occupies less than an hour in delivery, and gives a very clear idea of the country and its people.

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* Cavalieri was born in Milan in 1598; he died in 1647. The above is extracted from a work entitled "Lo specchio Ustorio: onero trattato delle settioni Coniche et alcuni loro mirabili effetti intorno al lume, caldo, freddo, suono, et moto ancora." Bologna, 1632.

* CHEMICAL NEWS, vol. xx., p. 13.

† "On the Theory of Phlogiston," *Philosophical Magazine* for January, 1868.

‡ The last two treatises are published in the *Recueil de Rapports sur l'état des Lettres et les Progrès de Sciences en France*, a series of which it would be difficult to speak too highly.

THE LATE DR. THOMAS GRAHAM, MASTER OF THE MINT.*

On Thursday, September 23rd, the remains of this distinguished man, attended by a number of his sorrowing relatives and personal friends (among the former of whom were his sister, her husband, and family), were conveyed to their last resting place in the High Church Burying Ground, Glasgow.

But few persons were privileged to any intimate acquaintance with Dr. Graham. He was never strong enough physically to allow him to mix much with society; he was always, or with rare exception, strong enough to toil in the field of science. Even scientific men, owing to his retiring habits, have not seen so fully the bearing of his labours, as they have seen of that of others in kindred pursuits, which will have much less influence. The reason of this will be at once apparent when we consider that he never pursued a merely popular or fashionable subject of investigation, and that he never sought a fashionable assembly in which to disclose the results of his labours, nor did he ever leave his own field of inquiry, although all the highways around him were bustling and busy, and if any person occasionally ventured near him it was only to find that there was nothing to be seen till he pointed something out. We do not pretend to be able to see and appreciate the entire significance of his scientific life—it would for this require much more study than we have given to it—and it will probably require many years for scientific men to develop the ideas originated by him. We can only endeavour to picture to ourselves the scene as he found it, and again as he left it touched by his master hand. Picturing in this connection is scarcely the right word—slight sketching is a phrase too strong for all that we can here attempt.

The general mind of the time has not yet arrived at a right apprehension of chemistry proper. The prevailing notions on the subject, even among well-educated persons, relate to the chemistry of a byegone time, and belong rather to the end of the last century than to the science of the present day. In that earlier time, the elements or simple bodies had been increased in number, and it was that there existed numerous bodies hitherto unsuspected. England had proved the existence of many of these elements, France had arranged them, adding more, and giving a theory of their action, and making a preliminary science from the materials thus created. Lavoisier saw first the qualities of combinations made by metals and other solid bodies with gases, and gave us a definite and clear nomenclature for the science. Wenzel and Richter tried long to make it clear that the constituents of substances must be proportionate and definite, but it did not appear possible to perceive by what innate process these proportions could be produced, and the whole question seemed to involve an inpenetrable natural mystery. Dalton, in the simplicity of his mind, looked on matter as composed of exceedingly small bodies, probably round in form, like those conjectured by his great predecessors, from Leucippus to Newton, and thought that if we have one substance represented by black marbles, and another substance by white marbles, neither of which could be broken or divided, we cannot help forming definite compounds in chemically uniting them. That great idea of Dalton has been at the root of all advance in the science, and if any analysis is in contradiction to it, we at once deem it incorrect. When Dalton was publishing his opinions Graham was born, and it seems that from very early manhood it had been his desire to know more of the movements of these atoms. In a paper by him as early as 1829, he showed that diffusion of gases takes place among ultimate particles or atoms, and not between sensible masses. This, then, was a new step. Dalton had shown why they combined in definite proportions, Graham showed that there was another property, a distinct movement—a vitality, so to speak, among the atoms. If, as Graham found, gases diffused through porous substances, such as he operated with, they were not driven forward mechanically, so that the mixture should pass like water, but the diffusion volumes are inversely as the square root of the densities of the gases employed in the experiment. If the gases were pressed out or expelled from the containing membrane, no air would return to supply their place; but it was found there was always an interchange of gases—for example, when hydrogen (contained in a tubular glass vessel having its open ends closed with stucco plugs), spontaneously passed through the stucco, air passed in with a velocity denoted by 1277; if carbonic acid were used it passed out, whilst air passed in with a velocity of 623 only. Chlorine being used, the air passed in with a velocity equal to 302. From these results Graham was led to believe in Dalton's idea that gases were as *vacua* to each other—an imperfect explanation of the phenomena—although it was empirically correct. In 1831 he said—"The law at which we have arrived, which is merely a description of the appearances, and involves, I believe, nothing hypothetical, is certainly not in accordance with the corpuscular philosophy of the day, and is altogether so extraordinary that I may be excused for not speculating further upon its cause till its various bearings and collateral subjects be fully investigated." Graham leant, however, to the belief that the cause was the existence of an attraction of the particles of one gas for the particles of another, an attraction existing on the surface of the gaseous molecules. This idea led him to study the diffusion of liquids. In this inquiry he came to the conclusion that "diffusion" is a property of a fundamental character upon which the properties depend, such as the volatility of substances. Liquid diffusion thus supplies the densities of a new kind of molecules. "The fact that the relations in diffusion of different substances refer to equal weights of these substances and not to their atomic weight or equivalents is one which reaches to the very basis of modern chemistry. In liquid diffusion we deal no longer with chemical equivalents or the Daltonian atoms, but with masses even more simply related to each other in weight than the former. Holding still by the chemical atoms we may suppose that they can group together in such numbers as to form new and large molecules of equal weight, or of weights which have a simple relation to each other. It is this new class of molecules which appeared to play a part in solubility and liquid diffusion, and not the atoms of chemical combinations." The vast importance of this conclusion, resting upon experimental evidence, every chemist will at once understand.

It will thus be seen that, after a struggle of twenty years, Graham was able to speak of chemical movements not essentially connected with the atomic theory of Dalton. Still, it must be remembered, that these are movements, not combinations. They had, however, an important bearing on decompositions produced by liquid diffusion.

It was in examining this question that he observed the low diffusive power of albumen compared to common salt, for example, and conceived a mode of proximate analysis for mixed animal fluids. Strange to say, he found this diffusive power of liquids was closely allied to volatility. This is due to a cause about the last that even cultivated people generally would have imagined. Diffusion, as practised, was simply the passage through a thin membrane of gelatinous matter, or, as we may say, of parchment-paper as the material used. By observing this, he was able to divide bodies in solution into two classes, severally called by him "Colloids" and "Crystalloids." If a liquid containing examples of these two bodies were placed in a vessel, one side of which is of parchment-paper, whilst on the other or outside of it there was water, it was found that the crystalloid substance passed through the paper into the water, whilst the colloid substance remained. In his earlier papers on

* Communicated.

the diffusion of gases, he had shown that it was only in the hypothesis of self-motion that we could account for the motion of the air within the smaller vessels of the lungs, as they could not be inflated or filled by the action of the chest and diaphragm, which removed only about 20 cubic inches of air at a time, while there were 300 cubic inches of air to he filled and emptied. In this paper on diffusion, the passages of saline fluids through membranes are explained; and the separation of bodies in solution is also shown by a similar self-acting process. We cannot follow him further into his ideas respecting colloid substances, which, he says, possess *energia*. He regards these latter as being matter in a dynamical state, whilst crystalloids are matter in a statical or rest condition. Ever, we should observe, does Graham look at the ultimate properties of bodies; he keeps the atom in view, or, at least, the fundamental matter, and always finding some new property regarding it, freed from the thousand years of exhausted speculation, but illuminated by experiment and answers obtained by such acute cross-questioning of Nature as no one before him, in that department, at least, ever equalled. We may say, further, without fear of contradiction, no one has succeeded, by such original paths, in obtaining an entrance into the domain of Nature. In speaking of diffusion through membranes, he makes it quite clear that the latter does not act as a filter. The substance is mechanically impenetrable: molecules pass through it, not masses. These molecules are moved by the power of diffusion. It was when examining the action of a septum of caoutchouc separating gases that his attention seems to have been called to the surprising passage of gases through the homogeneous substance of a plate of fused platinum, or of iron at a red heat, as discovered by MM. St. Claire Deville and Troost. He enquired if this had any relation to liquefaction, and concluded that such a term could only be applied in a vague way to bodies so elastic and volatile at an elevated temperature as the gases are, and hydrogen in particular. Still, since dissolving and liquefying must be allowed, with such a fact before us as silver retaining twenty volumes of oxygen at a red heat, Graham also believed that the absorption of gases by a liquid (such as carbonic acid by water) is not a purely physical effect. It appears to involve some relation in composition. In the composition of the bodies, he adds—"May a similar analogy be looked for of hydrogen to liquid on colloid bodies of the metallic class?" It was in following up this idea that he came to the conclusion that hydrogen might pass into metals, and form with them an alloy. This alloy he succeeded in making, and a medal of palladium and hydrogenium was struck in his honour. The hydrogen in this condition and connection was called hydrogenium, in order that the name might have a termination like the names of the metals which it resembled. The palladium contains nine hundred volumes of a substance so light as hydrogen, and so many thousand times lighter than itself. This brilliant discovery had other results. Iron was found to absorb gases when cooling; and it was, therefore, possible to know in what gas iron did cool by finding the gas shut up or included in it. The technical value of this may still be very great; but Graham cared little for such results. He sought cosmic truth; and he had a wonderful proof of his own correctness by the examination of cosmic phenomena. He found that the gas which was shut up in iron made by man was carbonic oxide, but the iron from space, or meteoric iron, contained hydrogen. This gas he took for us out of the meteoric iron, and burnt it. It was hydrogen. Strange that at that time a small star had increased in brilliancy, and become a large one. The spectroscopist found, by the evidence of the spectrum lines, that hydrogen was burning. Graham's quiet and, to all appearance, uninteresting, unimportant, and even dull, experiments, that nobody cared to share with him, had at last resulted in two of the most brilliant facts, which even cultivated minds must long wonder at and admire. Reference to one of his latest speculations must finish our present notice of this distinguished man. That gases have initial movements as one of their original properties, and that the speed of these movements severally may be their main distinction. This would take them out of the region of chemistry proper, and bring them into physics; but physics and chemistry are, after all, fundamentally one. A new field is unfolded to us; new work must be done, and new workers are required. Who among us will give up all the ordinary gratifications and amusements of life to work in this field like Graham? Who among his fellow chemists will do work worthy of being placed beside his? We may freely say that such another will not soon arise, and, if our country produces such a man in a century, she does her duty well, even if the rest are only of average powers.

We cannot go into the detail of the labours of Graham. We have left out his enquiries into the action of water, basic and constitutional, in chemical compounds; his able papers on the arseniates and phosphates; and we have said nothing of osmotic force by name; neither have we done justice to his enquiries on effusion and transpiration; but we have hastily, after his funeral, tried to remember the main points of a great scientific life, and we trust they will be more closely studied than heretofore by all scientific men. We are almost ashamed to allow such a meagre account to stand as representative of the labours of such a man; but it is only for a little, as a longer and more detailed life must soon be written by men who will give much time, care, and competent thought to every portion of the publication. We need scarcely speak of Graham in private. Such enquiries will always have one result in showing that he was pure-minded, just, generous, and kind-hearted to the uttermost. Humble he was, quiet, and as simple-minded to the last as if he were always the same hoping, trusting youth that he seemed to be when he first began to lecture in the Andersonian Institution thirty-nine years ago. By his death, Scotland has lost, at a somewhat early age, one of her brightest scientific names, and Great Britain and the world one of the greatest chemists of the present or of any period.

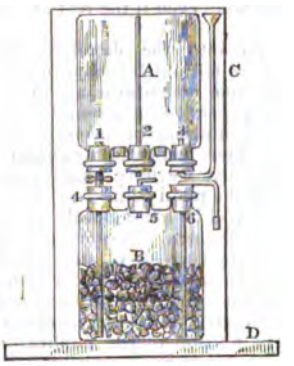
LABORATORY NOTES.

ON A CONVENIENT FORM OF SULPHURETTED HYDROGEN APPARATUS FOR LABORATORY USE.

Of the many forms of apparatus that have been proposed for the generation of sulphuretted hydrogen, very few allow themselves to be changed so as, at a moment's notice, to give a steady and constant stream of the gas without a slight but continuous escape taking place. In large laboratories, where many analyses are being carried on at the same time, and a large amount of the reagent used, the form described by Fresenius in his "Qualitative Analysis," similar to the hydrogen apparatus used in making sulphuric acid chambers, is all that can be desired. Lead, however, is scarcely a suitable material for smaller apparatus, and glass must be substituted. The old form, with three bulbs, is sometimes used, but these are expensive, and objectionable, inasmuch as, when charged, but not in use, the acid is only prevented from falling and acting on the sulphide by the volume of gas below, so that a variation in the temperature, or very slight leak in the connections, or even the porosity of many varieties of india-rubber tubing, is sufficient to keep up a constant action. The form to be described combines, on a small scale, the advantages of both.

In the figure, A and B are two Woulf's bottles, each furnished with three necks, one held over the other by

means of two wooden supports, passing between the necks, and so shaped as to fit the bottle, firmly secured to a backboard, C, which, again, is strongly fixed to the base-board, D. A may be rendered more secure by further connecting it with the backboard at the top. Each of the necks is fitted with a good cork. A short and rather broad tube is inserted in cork No. 1. No. 4, opposite to it, is furnished with a tube of equal size, reaching to the bottom of B. These tubes are connected by means of a piece of india-rubber tubing, with sufficient space free to allow of the latter being closed by a Mohr's pinch-cock. Through No. 2 passes a small tube, reaching to the top of A and terminating immediately below the cork. In No. 3 is inserted an acid-funnel, the tube reaching on the



inside just above the cork, and bent upwards outside so that the funnel shall be on a level with the top of the apparatus. Through No. 6 passes a tube long enough to reach to the bottom of B: the outside end of this is bent downwards, and terminates in a small piece of india-rubber tubing, which can be plugged with a piece of glass rod. The central neck is furnished with an exit-tube for the gas, the stream from which must be regulated by means of an india-rubber tube and screw-clamp. About one-third of the lower bottle is filled with small pieces of flint, and on this the sulphide of iron is placed.

To charge the apparatus, the tube at No. 6 is closed, and sufficient acid poured down the funnel to cover the sulphide. When the egress of the gas is stopped, the liquid passes up through No. 4 to A, the air in the latter escaping through the small tube at No. 2. When all the liquid has ascended, the connecting tube at No. 4 is closed by means of the pinch-cock, and the lower bottle relieved from the pressure. When the acid becomes exhausted, it may be drawn off by removing the stopper at No. 6, when, if the liquid is in the upper vessel, it will at once run off; if, however, the exhausted solution is in the lower vessel, it must be removed by blowing in at No. 5. The outside limb of No. 6 may be made long enough to act as a syphon, when the necessity of blowing would be avoided: it would then, however, be easily broken.

E. W. Parnell.

Runcorn, Sept. 25th, 1869.

MISCELLANEOUS.

The Proposed New Chair in the Andersonian Institution.—In our Students' Number we stated that Mr. Young's new chair of technical chemistry had been accepted by Mr. W. H. Perkin; and, as the appointment had received the sanction of the trustees, we were justified in making the announcement. We are, however, now informed that the managers have asked the trustees to cancel the entire arrangement, and we accordingly hasten to notice this fact, especially as the present Professor of Chemistry in the Institution considers our announcement detrimental to his interests. We have received two pamphlets, one being Dr. Penny's remonstrance and appeal against the appointment of an additional Professor of Chemistry, and the other Dr. Adams's reasons of protest; from these we gather that, as Dr. Penny has always instructed his pupils in technical chemistry, and as his income is derived from class-teaching, the new chair would greatly interfere with his interests. Dr. Penny has expressed his willingness to consider any arrangement for carrying out Mr. Young's intentions, provided his titles, rights, &c., are preserved; or, for the actual progress of the Institution, he is willing to vacate his chair on condition of receiving a reasonable compensation for his apparatus and the loss he would sustain. We have no doubt that Mr. Young will adopt some means of carrying out his munificent endowment, without that injury to present interests which it would certainly cause if the original scheme were to be adopted without considerable modifications.

Irrespirable Air of the Wine-Must Fermenting Tubs.—M. Saintpierre.—It is a well-known fact that the four Departments of the South of France, named l'Hérault du Gard, l'Aude, and Pyrénées-Orientales, produce, year after year, about 12,000,000 hectolitres (every hectolitre is rather more than 22 gallons) of wine; every hectolitre of must gives off an average 2500 litres of carbonic acid gas, and, since the size of the fermenting tubs is such that each one contains with ease 400 hectolitres of liquid, one may readily imagine what a quantity of carbonic acid there will be disengaged, considering that, during the short space of from 2 to 3 weeks, from 500 to 1000 hectolitres of must are ready for fermentation in confined localities, generally of no more cubic capacity than 1000 cubic metres (rather more than 35,600 cubic feet). The gas given off during the fermentation has a rather high temperature, and is, moreover, charged with the vapours of various ethers and alcohols, simultaneously the products of the fermentation. Even to those accustomed to this sort of atmosphere its effect upon the system is very marked. Quicklime is very commonly placed in the cellars wherein the fermenting tubs are placed, and a good ventilation kept up. The author of this paper has found, however, that nitrogen is among the products of fermentation; he states that, in 1868, he found that the atmosphere of a large tub could not support the combustion of a candle, although the empty tub (the must and dregs had been removed from it for fully 24 hours before his visit) contained a large quantity of quicklime, and no indication was found of carbonic acid. On analysis of the air contained in this tub it proved to consist, in 100 parts, of:—Oxygen, 11·85; and nitrogen, 88·15. Only the best possible ventilation and plentiful use of lime and lime-water can make cellars wherein these fermenting tubs are placed fit for work-people.—*Journal de Pharmacie et Chimie.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of every chemical paper in the world, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* Chemical News, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, October 4. 1869.

A great portion of this number is devoted to lengthy discussions upon the manner in which the metrical system has been obtained. Those who have a desire to impugn its accuracy have brought forward several alleged facts relating to inaccuracies committed during the geodesical surveys which preceded the introduction of the *metre*. It is satisfactory, however, to find that these inaccuracies are only imaginary, and the discussions here alluded to fully bring out the important fact that those who desired to detract from the value of the work of the committee of 1790 are mistaken, even so much so as to confuse works of far later date (1808) with those done in 1789 and 1790.

Artificially-Crystallised Silver Amalgam.—M. E. Dumas.—It appears that at the Mint at Bordeaux (France now keeps up three

mint establishments—one at Paris and one at Strasbourg), there has been left standing, in an iron mercury bottle, a quantity of about 10 kilos. of that metal, which had been used to extract the silver out of some refuse residues. On filtering through chamois leather, there were left upon the filter a certain number of well-defined crystals, which, on analysis, were found to contain, in 100 parts:—Silver, 27·4; quicksilver, 72·6; and traces of gold. The native amalgam of these two metals contains, in 100 parts, silver, 36, and quicksilver, 64, corresponding with the formula $AgHg_4$. The crystals above alluded to correspond to the formula, $AgHg_8$.

Disappearance of the Acids of the Grape and their Probable Conversion into Sugar.—M. Petit.—The author states that the ripening of grapes is accompanied by the disappearance of a large quantity of acid. Green, unripe grapes yield, on an average, 36 grms. of acid to the litre. When the grapes ripen, they double in bulk, and ought, if only water had been added during the process of ripening, to have yielded 18 grms. of acid to the litre, while only from 5 to 6 grms. is detected by analysis. It should be stated that this result is not due to the saturation of the acid by bases, since the ripe grape contains less base than the ripe grape does.

Constitution of Pseudotoluidine.—M. Rosenstiehl.—The author gives the following *resumé* of his paper on this subject:—"I wish to acknowledge an error formerly made, to point out that the constitution of pseudotoluidine is not yet accurately known and well established." Lastly, the author states that he does not intend to pursue studies on this subject any further. The paper is chiefly a critical review of the labours of others on this subject as compared with those of the author.

Cosmos, October 2, 1869.

Manufacturing Manure from Offal of Wool.—M. Pichelin.—Fifty kilos. of this offal are mixed with 33 kilos. of concentrated sulphuric acid and 35 kilos. of nitric acid, sp. gr., 1·321. This mixture is well stirred up for about ten minutes, and next mixed with some native phosphate, coprolites, for instance, in the proportion of 100 kilos. of the acid mixture to 200 kilos. of very finely ground up phosphates. This manure becomes, in forty-eight hours, as hard and dry as rock, so that it has to be ground up again under mill-stones.

Conservation of Wood by Solutions of Salts of Copper.—M. Morin states that he has in his possession wooden water-wheels which have been in use for more than 1500 years for the evacuation of water from a copper mine. These wheels have a diameter of 6 metres; and, on a portion of the wood being analysed by M. Payen, it was found to be perfectly sound, and to be partly converted into a compound of cellulose and copper, precisely similar to that which is formed in Boucherie's process for the preservation of wood by sulphate of copper.

Tanned Cotton, also called cotton-leather, is prepared by treating cotton fabrics in a similar manner to that in which skins and hides are treated for the manufacture of leather. Cotton hereby acquires greater strength, and is more enabled to resist the effects of moisture and disintegrating efforts.

Zeitschrift für Chemie von Beilstein, No. 16, 1869.

We find in this number the following original papers:—

Test for Arsenic and the Preparation of Hydrochloric Acid free from Arsenic.—M. Bettendorff.—When arsenious or arsenic acid is dissolved in fuming hydrochloric acid, and there is added thereto a solution of protochloride of tin dissolved in hydrochloric acid, a brown-coloured very bulky precipitate, which rapidly settles down, is formed, which precipitate, after having been collected on a filter and washed, first with hydrochloric acid, next with water, to remove the latter entirely, constitutes, after having been dried over sulphuric acid *in vacuo*, a greyish coloured powder, of metallic aspect; this, on being rubbed in an agate mortar, exhibits metallic lustre, and is volatile on being heated, while oxide of tin, in the shape of a very light powder, is left. On being analysed, the precipitate was found to consist of from 98·46 to 95·86 per cent of metallic arsenic, according as to its preparation, arsenious acid, arsenic acid, or arseniate of ammonia and magnesia had been applied. The precipitate could never be obtained quite free from tin. The author further states that when the hydrochloric acid employed has a sp. gr. of 1·115, the arsenious or arsenic acids dissolved therein become, if not entirely, at least for the major part, converted into chloride of arsenic; and the reaction described, therefore, takes place between that chloride and protochloride of tin. When the hydrochloric acid has a sp. gr. of 1·100, the arsenious acid is not converted into chloride of arsenic, but is dissolved as arsenious acid; chloride of tin does not act upon combinations of antimony under the same conditions. The author advises that crude hydrochloric acid, sp. gr. 1·164, should, in order to eliminate all arsenic from it, be treated with a strong solution of protochloride of tin in pure HCl, left standing for twenty-four hours, the precipitate removed by filtration, and the acid next placed in a retort, the first 1-10th of the distillate kept separately, and the remainder distilled off to dryness, when that portion will be found absolutely free from arsenic; the first 1-10th might, in some cases, retain 0·02 per cent of that metal.

Orthoxylol, a New Modification of Dimethyl-Benzol.—MM. Bieber and Fittig.—The authors have discovered a new hydrocarbon, C_8H_{10}, which differs from isoxylol and methyl-toluol, and has been named by them *orthoxylol*. It is a fluid body, and boils at 141°; it is distinguished from other substances of isomeric composition by the difficulty wherewith it yields nitro-combinations, and, also, by the slow action which a mixture of chromate of potassa and sulphuric acid exerts upon this substance.

On Bromotoluol, Bromotoluol-Sulpho Acid, and Isomeric Sulpho-Hydrate of Toluol.—MM. Hübner and Wallach.—This rather lengthy paper is not at all suited for any useful abstraction with due justice to the labour of the authors.

Action of Sulphurous Acid upon Chlorids of Platinum.—M. Birnbaum.—The author reviews, at some length, the labours of other investigators on this subject, and then states that, when ammonio-chloride of platinum is placed in a concentrated aqueous solution of sulphurous acid, and the mixture heated on a water-bath, care being taken to keep excess of sulphurous acid, a yellow solution is obtained; this solution was evaporated to dryness, again some aqueous SO_3 added to it, and dried over SO_3. A compound was obtained in crystalline state, which contained platinum, ammonium, chlorine, and sulphurous acid—$Pt:3Cl:SO_3:2NH_4$. When the strongly acid solution of ammonio-chloride of platinum in sulphurous acid was saturated with carbonate of potassa, a salt was obtained wherein the different component bodies were contained in the proportion expressed by $Pt:3Cl:SO_3:2NH_4:K$. This salt is the potassa salt of the acid first obtained by the action of SO_3 upon ammonio-chloride of platinum in combination at the same time with chloride of ammonium. The formula of the acid just alluded to is—

$$Pt\left\{\begin{matrix}Cl\\HSO_3\end{matrix}\right\}+2NH_4Cl.$$

The author succeeded, by means of a complicated set of experiments, in substituting, for both atoms of chlorine of the chloride of platinum, the radical HSO_3, and thus obtained a crystalline compound—

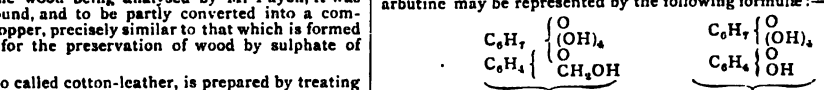
$$Pt\left\{\begin{matrix}HSO_3\\HSO_3\end{matrix}\right\}+2NH_4Cl+H_2O.$$

No. 17, 1869.

This number contains the following original papers:—

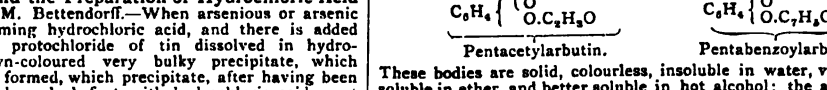
Contribution to our Knowledge of Isomerism in the Benzoic Acid Series.—M. Hübner.—This memoir is a critical review of the labours of M. V. von Richter on the subject above named; and the author defends his own experiments on this subject, and proves that M. V. von Richter has made several mistakes. The paper is not suited for abstraction.

On Arbutine.—M. A. Schiff.—Just in the same manner as salicine can be split up into glycose and saligenin, arbutine is split up into glucose and hydrochinon. The relation between salicine and arbutine may be represented by the following formulæ:—



Salicine — Glycosalicyl-alcohol. Arbutine — Glycohydrochinon.

Benzoyl-arbutine is prepared by means of chloride of benzoyl; the acetyl-arbutine is prepared by the action either of acetyl-chloride or of acetic anhydride. The final products of these reactions contain five acid radicals, and are made up according to the following formulæ:—



Pentacetylarbutin. Pentabenzoylarbutin.

These bodies are solid, colourless, insoluble in water, very slightly soluble in ether, and better soluble in hot alcohol; the acid radicals can be removed by boiling with weak bases. The author's paper is full of a series of formulæ similar to those here quoted; he states that an aqueous solution of arbutine reduces freshly precipitated oxide of silver readily at a low temperature. A solution of arbutine yields, with solution of perchloride of iron, a deep blue colouration, which gradually disappears; but the derivatives obtained from arbutine do not do so.

Isomeric Nitrotoluols and Toluidines.—MM. Beilstein and Kuhlberg.—After referring to the experiments made on this subject by M. Rosenstiehl, the authors state that the party just named did not enter into any particulars as regards the splitting up of nitrotoluol ihto its different components—that is to say, all of them nitrotoluols differing from each other by slightly modified properties, the various bodies being distinguished by the prefixes *a*, *β*, and so on. The paper is rather a catalogue of formulæ, and is divided into five sections, treating of the sulpho-acids; toluidines and para-toluidines; aceto-toluides; toluidine derived from xylol; and *β* chlorotoluol, $C_6H_4Cl.CH_3$. The authors, moreover, state that this paper is intended only as a general survey of the subject, and that they continue their researches thereon.

Isomeric Nitro-Ethyl-Benzol and Xylidine.—MM. Beilstein and Kuhlberg.—*a* nitro-ethyl-benzol boils at 246°, has a specific gravity of 1·124 at 25°, and is a yellow-coloured fluid; *β* nitro-ethyl-benzol is also a liquid, boils at 227°, sp. gr. 1·126 at 24°. The *a* compound is capable of yielding acids; not so the *β* compound. *Xylidine*, $C_6H_3.C_2H_5.NH_2$, corresponding to the *a* nitro-toluol, *boils 214°*, is a limpid liquid which becomes readily brown-coloured on exposure to air; sp. gr. 0·975. The *β* xylidine boils at 210°. Acetoxylide, $C_6H_3.NH(C_2H_3O)$; the *a* compound boils at 317°, fuses at 94°, and is somewhat soluble in hot water; the *β* compound is readily soluble in hot water, and boils at 305°; both are solid bodies.

On Dichloric and Trichloric Benzoic Acid.—MM. Beilstein and Kuhlberg.

Derivatives of Benzol obtained from Toluol.—MM. Beilstein and Kuhlberg.—These papers are not well suited for abstraction.

On Paratoluidine.—MM. Hübner and Wallach.—Paratoluidine is a liquid which in pure state resists a cold of −21° without becoming solid, is very readily soluble in alcohol and ether, and rather soluble in water; with acids, it yields salts which crystallise. Sulphate of paratoluidine, $(C_6H_4NH_2.CH_3)2SO_4H_2$, is very readily soluble in water. Acetoparatoluide, $C_6H_4.CH_3.NH.C_2H_3O$, is a solid body exhibiting needle-shaped crystals, fusing at 105°, soluble in alcohol and ether, but not readily soluble in water.

Solubility of Nitrates in Nitric Acid; Separation of the Nitrates of Potassa and Soda from each other.—M. C. Schultz.—Nitric acid does not form acid salts. Several nitrates which are readily soluble in water are difficultly soluble in nitric acid; and this fact explains why silver, lead, and iron are not readily acted upon by very concentrated nitric acid. One part, by weight, of the undermentioned salts require for their solution in—

	The First Hydrate of Nitric Acid, HNO_3.	Hydrated Nitric Acid, $2HNO_3+3H_2O$.	
		(At 20°.)	(At 123°.)
	Parts.	Parts.	Parts.
KNO_3	1·4	3·8	1
$NaNO_3$ ..	66·0	32·0	4
$LiNO_3$ ..	200·0	—	—
$AgNO_3$ ..	500·0	30·0	6

The nitrates of baryta, strontia, and lead are as insoluble in both the above-named nitric acids as the sulphates of these metals are in water. The nitrates of potassa, rubidium, and ammonia are readily soluble in hydrated nitric acid. The author is of opinion that the by far greater solubility of nitrate of soda than nitrate of potassa in nitric acid might be applied to the separation of these salts from each other; but the author very properly observes, also, that working with nitric acid, especially on the large scale, is, in many instances, impracticable. For analytical purposes, this plan is not suitable, since chloride of sodium is rather insoluble in nitric acid.

No. 18, 1869.

This number contains the following original communications:—

Researches on the Sulpho-Acids of Benzol.—M. Ross Garrick.—This paper contains an enumeration of the most prominent salts of the three following acids:—From benzolsulpho acid, C_6H_4Br,SO_4HO; isobromobenzolic acid, $C_6H_4BrSO_3HO$; benzoldisulpho acid—

$$C_6H_4\begin{cases}SO_3HO\\SO_3HO\end{cases}$$

Without reproducing a very lengthy series of formulæ, the chief contents of this paper, we do not find therein anything worth much notice, and therefore abstain from further quotation of its contents.

New Method of Converting Fatty Acids into their Alcohols.—Dr. Saytzeff.—This is simply a preliminary notice, *pour prendre date*, written from Kasan. The author says that, when sodium amalgam is suffered to act upon a mixture of fatty acids and their anhydrous chlorides, the alcohols belonging thereunto are obtained; for instance, acetic acid and acetyl-chloride yield ethylic alcohol. The author promises full and complete details in a future paper.

Formation of Aniline from Bromide of Benzol.—MM. Hübner and Alsberg.—This paper is also marked "preliminary notice." It is written with the object of elucidating the question, Whether the atoms of hydrogen contained in benzol do all occupy the same rank? In order to settle this point, the authors have set to work to obtain, from different bromated and chlorinated benzols, anilines, and to compare these mutually. For this purpose, bromide of benzol was nitrified, with the result that two varieties of bromonitrobenzol were obtained; one of these compounds, evidently, is the same as that described by M. Couper; the other compound is a monobromonitrobenzol, fusing at about 38°, and yielding, on being amidised, two bromoamido compounds. The bromonitrobenzol (Couper's) fuses at 125°, and yields, on being treated with tin and hydrochloric acid, an amido compound, $C_6H_6BrNH_2$; this, on being first treated, while in alcoholic solution, with sodium, and next with chloracetyl, yielded an acetanilide, fusing at about 116°, soluble in water, and more readily soluble in alcohol and ether. The authors promise full details on this subject afterwards.

Thihydrobenzoic Acid.—MM. Hübner and Upman.—A short "preliminary notice." When sulphobenzoic chloride is brought into an apparatus wherein hydrogen gas is briskly evolved from tin and HCl, a white substance is separated, which, on being collected on a filter, washed with water, dissolved in ammonia and re-precipitated by HCl, and boiled in alcohol to which HCl is added, there is obtained a solid crystalline substance, a compound which, on being submitted to elementary analysis, was proved to consist of $C_6H_4.SH.COOH$; this body the authors have named thihydrobenzoic acid; it fuses at 242°, is difficultly soluble in alcohol, and insoluble in water.

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt. First two numbers for 1869.

Of this periodical, published by the Austrian government, one number is published at the end of each quarter of the year. Very frequently these papers contain the results of chemical researches and analyses, and these we briefly abstract:—

Phosphatic Nodules from the Chalk Formation of Russian Podolia.—Dr. Alth.—Leaving the purely geological portion of this paper, and the discussion on the origin of the phosphatic nodules in general, and especially of the variety here alluded to, the author states that the result of the analysis for this mineral is, for 100 parts:—Water, 0·65; silica, 14·18; lime, 26·12; fluorine, 11·69; alumina, 0·99; phosphoric acid, 23·50; iron (*eisen*), put down as metal, 9·23; cobalt, 4·60; manganese, 1·40; sulphuric acid, 2·10; magnesia, 3·52; potassa, 1·20; loss, 0·82.

Analyses of Several Kinds of Common Salt from Galicia.—M. A. von Kripps.—This paper is sub-divided into several sections. The average composition of rock-salt from Stebnik is, in 100 parts:—Chloride of sodium, 90·281; chloride of potassium, a trace; chloride of magnesium, 0·286; chloride of calcium, 0·508; sulphate of lime, 8·245; water, driven off at 160°, 0·680. Rock-salt from Kossow contains, in 100 parts:—Chloride of sodium, 98·0; alumina, 1·7; loss by heat (water driven off at 160°), 0·2. We have only selected a couple of samples from among a number of about one hundred. It appears that Galicia is very well provided with deposits of rock-salt, which is wrought out by mining processes, and that, by boring, saline springs of sufficient strength to admit of boiling down and obtaining salt thereby, are found in large number.

Researches on the Mineral Water of Rajec-Toplitz.—M. E. Glasel.—In a remote portion of the Comitate of Trentschin, near Sillein, a mineral spring is met with, the water of which is the subject of this memoir. The temperature of this water varies from 26·5° R. to 20·4° R. The water is colourless, devoid of smell, has a saline astringent taste, and exhibits, in its natural state, alkaline reaction. In 100 parts, the composition of the dry saline residue is quoted as follows:—Calcium, 52·63; magnesium, 33·29; sodium, 9·21; potassium, 2·83; aluminium, 2·02; oxide of iron, a mere trace; carbonic acid, 82·17; sulphuric acid, 16·57; chlorine, 1·31; silica, 0·80; phosphoric acid and iodine, a trace; free carbonic acid, 7·05; sp. gr., 1·000768.

Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 7, 1869.

This number contains only one paper relating to chemistry:—

Presence of Chloride of Sodium in the Water and Rocks of the Coal Formation of Luijk (Liège).—M. R. Malherbes.—The paper here quoted is not the original work of the author, but two reports on his paper, one of which is written by the well-known M. Omalius D'Halloy, the other by M. Dewalgue. Both these gentlemen differ from the author above-named, as regards his opinion that the formation of coal should have taken place in salt-water ponds; but they also state that it is difficult to explain why some samples of sandstone of the locality above named should contain 0·101 per cent of chlorine, while in other samples of the same stone, and in the same locality, no chlorine is found at all. Some of the schistose rocks contain 0·085 per cent of chlorine; others, again, none of this element, notwithstanding they are found close by each other and evidently belong to the same geological formation.

Journal de Pharmacie et de Chimie, September, 1869.

This number contains the following original articles:—

Laws which Regulate the Part any Substance Plays between Two Solvents.—MM. Berthelot and Jungfleisch.—A paper on this subject, recording researches of the same nature, was published by these authors, and noted by us from the *Comptes Rendus*, therefore we do not further allude to it here.

Purifying of Bromide of Potassium.—MM. Bobierre and Herbelin.—The authors state that when bromide of potassium is adulterated, or mixed with iodide of potassium, it is, in order to detect this, only necessary to place a few grains of the salt in question on paper previously impregnated with starch paste, to moisten it, and admit a small quantity of chlorine gas, whereby the iodine is set free and the paper coloured blue. A better test, given by the authors, is the use of bromine, added to the salt after it has been placed under benzol; if the latter becomes red-coloured, iodine is present. The title given to this paper should have been "On the Detection of Iodine in Bromide of Sodium."

Preservation of Eggs.—M. Violette.—The main results of this paper are the already long known facts that eggs may be kept in perfectly fresh state by varnishing them over with a so-called drying oil, linseed oil being preferred on account of its cheapness; poppy-seed oil also answers this purpose perfectly well.

Bayerisches Industrie und Gewerbeblatt, July and August, 1869.

These two numbers, published together, contain, among the officially-published material, most excellently drawn-up and well-digested law, and police regulations, for the management and traffic of the railways of the Kingdom of Bavaria. The duties, as well as the rights, of the officials thereby employed, as well as of the travelling public, are clearly and distinctly defined, and every care and precaution is taken to insure the safety and comfort of all concerned. Even in a technical point of view, this document deserves the notice of all who have anything to do with, or authority over, railways, which, as evidenced also in Bavaria, are better managed, and with more profit to the nation at large, by the State than by private companies.

Ceramic Industry of Krönningen, Lower Bavaria.—Dr. Wimmer.—The kingdom of Bavaria is rich in various qualities of

clay fit for the most varied kinds of pottery, from the finest china, made near Nymphenburg, to the coarse but highly refractory clay which is made up in so-called Passau melting pots. The clay referred to in this paper, after having been dried at 100° (whereby it lost 21 per cent of water), gave, on being analysed, the following results for 100 parts:—Water, and trace of organic matter (lost by ignition), 2·02; alumina, 27·42; oxide of iron, and traces of oxide of manganese, 6·88; lime, 5·60; magnesia, 0·20; potassa, 0·18; silica, in combination, 19·20; sand and free silica, 38·40. No traces, even, of sulphuric and phosphoric acids, chlorine, and carbonic acid could be detected. This clay is fit only for very coarse pottery.

Schools for Brewing in Bavaria.—Dr. Zingerle.—It appears from this paper that there exist, at Munich and Augsberg, excellently arranged schools wherein everything which relates to the brewing of beer is taught practically and theoretically; and, from the enumeration of the students who attend, they being natives from various European countries, as well as from America, this instruction seems to be highly valued.

Polytechnisches Journal von Dingler, first number for August, 1869.

This number contains the following original papers relating to chemistry:—

Manner in which the Nitrogenous Substances are Divided in the Potatoes.—M. Dietzel.—This lengthy paper contains researches made by the author with the view to determine what portion of the tuber of the potato is richest in protein compounds; and since, according to this author, there exists a peculiar relation between the quantity of the fatty matter contained in this, as well as in other vegetables, he concludes that, where the largest quantity of fat is there also is relatively the largest quantity of protein. The results are quoted as follows:—The layer nearest the skin contains—Proteinoid, 14·16; fat, 0·66; quantity of proteinoid for one part by weight of fat, 21·45. Interior of tuber contains—Proteinoid, 9·50; fat 0·38; quantity of proteinoid for one part, by weight, 25·00.

Use of a Vacuum in Brewing.—M. Jicinsky.—This paper is so entirely of a practical nature that it is not exactly suited for our pages; but the author certainly proves the great benefits brewers would gain by adopting the use of vacuum apparatus.

Second number for August, 1869.

Among the original papers relating to chemistry, we find in this number:—

Peculiar Steam-Boiler Incrustation.—M. Reichardt.—On visiting a manufactory situated on the higher portion of the Thuringian river Saale, the author noticed a boiler incrustation, which, from its very dark brown colour, appeared almost to consist of an oxide of iron containing manganese. The analysis gave the following results:—Water, driven off at 100°, 2·10 per cent; insoluble in hydrochloric acid, 17·12; soluble therein, 80·78 per cent. Full analysis, in 100 parts:—Water, at 100°, 2·10; white clay and sand, 8·87; oil and pitch, 8·25; sulphate of lime, 1·80; peroxide of iron, 1·20; protoxide of iron, 0·22; carbonate of lime, 68·52; carbonate of magnesia, 9·60. The dark colour is due, not to the oxide of iron, but to the organic matter, oil, and fat, partly decomposed by the high temperature, and converted into a kind of pitch.

Chemical Investigation of Tablettes de Bouillon Russes.—M. Reichardt.—The substance here alluded to is not in commerce in the western parts of Europe, and is manufactured from the meat, not only of cattle, but also that obtained from game, which latter is very plentiful in the less inhabited portions of Poland and Russia. The researches of the author, who obtained the genuine material from a friend of his who resides in Russia, yielded the following results for 100 parts:—Water, at 180° (without any decomposition), 21·7; fatty matter, 0·22; nitrogen, 10·57; ash, 4·75; soluble in alcohol, 38·09 per cent. The author, having purposely compared these meat lozenges (for so they may be called) with Liebig's extract of meat, comes to the conclusion that the extract is superior in every respect, but that this is counterbalanced by the relative cheapness of the lozenges, and their very convenient portability and non-liability to decay.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, July, 1869.

This number contains the following original communications and papers:—

Researches on those Resins Derived from the Convolvulaceæ, which Act as Drastic Purgatives.—MM. Köhler and Zwicke.—This paper contains an historical review of the discovery and older analysis of *Scammonium jalappa*, and other substances less generally known and now obsolete in Europe, formerly used as physic, and produced by plants belonging to the natural order above named. The chemical researches of the authors are confined to convolvuline and jalapine; the former expressed by the formula $C_{72}H_{50}O_{32}$, the latter by $C_{68}H_{54}O_{32}$. These two substances behave with reagents in the following manner:—

Convolvuline is not soluble in ether, and is precipitated by it from its alcoholic solution; is entirely insoluble in benzol; when evaporated to dryness along with nitric acid, convolvuline becomes violet red-coloured upon the addition of SO_3. The acid solution of convolvuline is precipitated by alum solution. The alcoholic solution of convolvuline is not precipitated by a solution of nitrate of protoxide of mercury. Nitrate of silver produces, in solutions of convolvuline, a pulverulent, non-adhesive precipitate, immediately becoming black-coloured.

Jalapine is perfectly soluble in alcohol and ether; is soluble in benzol, but rather difficultly; but is readily taken up by benzol from its alkaline solutions when these are shaken up with benzol. Jalapine, treated as described, is not coloured at all. Acid solution of jalapine remains quite clear and undisturbed on being treated by alum solution; alcoholic solution of jalapine is precipitated by nitrate of protoxide of mercury, yielding a bulky, caseous precipitate, insoluble, also, on heat being applied. Nitrate of silver produces a bulky, caseous, whitish grey, clotted precipitate in solutions of jalapine, and this precipitate is only slowly changed by the action of the light.

These reactions may serve to distinguish between genuine resin of jalap, and between scammony and its resin.

Description of a Practical Chlorine-Water Apparatus.—Dr. Duflos.—There is added to this paper a woodcut, and, without reproducing it, it is not an easy matter to make this apparatus understood. The chief point is that the pressure of the gas escaping from a mixture of 2 ounces of dry bichromate of potassa, and 11 ounces of commercial hydrochloric acid, is made to saturate, with chlorine gas, 8 lbs. of water, by making the gas to force, by pressure, this quantity of water from one Woulf's bottle into another.

Detection of Wheaten Starch among Arrow-root, and of Wheaten Flour among Starch.—Prof. Boettger.—Take 1 grm. of the material to be tested, put it in a porcelain dish, and add 180 c.c. of distilled water; apply heat, and boil the mixture briskly while stirring continuously and briskly with a glass rod. Any starch which is quite free from gluten—for instance, pure potato starch, or pure arrow-root—will not exhibit, when treated in this way, any foam on the surface of the liquid as soon as the stirring is discontinued; but when the starch happens to contain the slightest trace of gluten, in other words, flour, there will appear on the boiling liquid, during the stirring up, a strong foam, which is so strong that it often resembles the foam on soap-suds.

August, 1869.

This number contains the following original papers:—

Gelatinæ Medicatæ in Lamellis.—Dr. Huseman.—This paper treats on the preparation of a peculiar kind of lozenges, pills, and gelatinous capsules fit to serve as vehicles for either very strong pharmaceutical preparations, which can only be given in very minutely small doses, such as as atropine, strychnine, and the like, or substances which are very disagreeable to the taste, as *balsamus copaivæ*, cod-liver oil, &c. The paper is strictly a pharmaceutico-technical one, and we therefore allude no further to it.

Preparation of Pure Hydrochloric Acid.—Dr. Rieckher.—The author mixes crude hydrochloric acid, sp. gr. 1·170, (containing 34·25 per cent real HCl), and sulphuric acid, sp. gr. 1·830 (containing 93 per cent of monohydrated acid), in the proportion of 100 parts, by weight, of the latter acid and 40 parts of the former (HCl), leaving, after distillation, whereby the HCl is volatilised, a sulphuric acid of 1·650 sp. gr. The loss of HCl in this operation amounts to about 3·5 per cent.

Cultivation of Opium in Germany.—M. Jobst.—This paper is altogether of a botanico-technical nature, treating on the mode and commercial advantages of cultivating the *Papaver somniferum* for the purpose of obtaining opium of good quality, which appears to be perfectly possible in some parts of Southern Germany.

Detection of Alcohol in Chloroform.—M. Blacher.—Add to the suspected chloroform a small piece of caustic potassa, and leave the fluid at rest for a few minutes; then add distilled water, and shake the chloroform therewith. Decant the water, and add a solution of a salt of copper to the aqueous fluid; if a precipitate ensues, the chloroform contains alcohol. Another, and perhaps more reliable, plan to detect alcohol in chloroform is to add to the latter a small piece of quite dry caustic potassa and a piece of reddened litmus-paper; if the latter becomes blue on being shaken up with the chloroform, it is sure to contain alcohol, provided always that it is quite anhydrous.

Revue Hebdomadaire de Chimie, September 16, 1869.

Names Given to Spirituous (Alcoholic) Liquids.—M. Mené.—It frequently happens that some industrial, or commercially-adopted, term for an alcoholic fluid is not properly understood, and this especially is the case with what, in and out of France, is known as *trois six*, 3-6. All alcoholic liquids are designated according to their strength, as indicated by Cartier's areometer for spirituous liquids. Liquids from 16° to 20° are called *eau de vie*, strictly translated water of life, or life-giving. Holland proof is spirit of 19° Cartier, strong *eau de vie*, brandy marks 21° or 22°. Above that degree, the fluids are named *esprits*, *spiritus*, and, by means of certain cypher figures, written as fractions, the greater or smaller quantity of water which these fluids require, in order to be reduced to the state of ordinary *eau de vie* of 19°, is expressed; for instance, *trois six*, 3-6, is an alcohol of 33°, three parts of which, by bulk, produce six parts of *eau de vie*. The *trois sept*., 3-7, is alcohol at 35°, three volumes of which form seven volumes of *eau de vie* at 19°. The word brandy is, no doubt, a contraction for *brantwein*, meaning, literally, burnt wine, since real genuine brandy is obtained by the distillation of certain wines, not as such fit for beverage.

Les Mondes, September 16, 1869.

Another Successful Artesian Well.—The well-known M. Say, the owner of the most extensive sugar refinery in France, situated on the Boulevard de la Gare, at Paris, has just got completed, at his manufacturing premises, the boring of an artesian well. At 562 metres

below the surface, a water layer has been reached, yielding 7000 litres of water per minute. The water, which has a temperature of 28° above zero, on reaching the surface rises to a height of between 20 and 30 metres above the end of the bore-hole at surface level. The cost has been 300,000 francs, and the work has been completed within four years, by the successors to the celebrated MM. Mulot, St. Just-Dru.

Comparative Review of the Composition of Milk from Various Mammiferæ.—In 1000 parts of milk, the undermentioned quantities of the following substances are contained in the milk of the animals respectively quoted:—

	Water.	Butter.	Caseine.	Sugar.	Inorganic matter.
Women	889·08	26·66	30·30	43·68	1·30
Cows	864·20	31·30	45·30	47·70	6·00
She Goats	844·90	56·87	35·14	36·91	6·18
Ewes	832·32	51·31	09·78	39·43	7·16
Mares	004·30	24·36	53·35	32·76	5·23
Asses	890·12	18·53	35·65	50·46	5·24
Sows	818·00	60·00	52·00	60·70	8·30

September 30, 1869.

Strengthening and Rendering Woven Tissues Impermeable to Water.—M. Neuman.—A sulphuric acid bath is made containing acid varying in strength from 40° to 66° Beaumé (specific gravities 1·384 and 1·850), and kept at a temperature of 57°. The woven tissues, cotton or linen, are rapidly passed through this bath, being only left in contact with the acid for from ten seconds to two minutes, according to the nature of the tissue, which is immediately after passed through very cold water, and next submitted to a thorough washing process. The effect of the action of the acid is an incipient dissolution, and formation of a varnish-like matter, which, especially after it has been regularly spread over the fabric, and incorporated therewith by hot-pressing and calendering, greatly increases the strength of the fabric, rendering it simultaneously impervious to water.

Annales de Chimie et de Physique, September, 1869.

This number is entirely filled up with a lengthy monograph, which bears the title—

New Researches on Thermo-Chemistry.—M. Berthelot.—We confine our abstraction to the headings of the different parts and sections of this paper. *Endothermic and exothermic reactions*:—Combinations formed with absorption of heat; on double decompositions; formation and decomposition of formic acid; fermentations and constitution of sugar; on compounds which develope heat when becoming decomposed and in nascent state; formation of protoxide of nitrogen and the decomposition of nitrate of ammonia; chemical action of light; on action by contact; on isomeric transformations; on the influence and effects of pressure upon chemical phenomena; changes of temperature produced by the mixing of divers fluids; general principle involved in all chemical reactions. *On pyrogenetic equilibrium*:—Decomposition of organic substances by heat. This memoir will be continued in another number of this periodical.

Journal für Gasbeleuchtung, August, 1869.

Among the original papers contained in this number we notice:—

What is Cheap Gas?—Dr. Schilling.—The contents of this paper, which is written with an evidently large amount of technical and commercial knowledge on this subject, might be very advantageously translated by our excellent contemporary, the *Journal of Gaslighting*. The idea of cheap gas is, indeed, a very relative one, since it is possible, by those well acquainted with all the *minutiæ*, of gas-making, to manufacture gas which, though nominally cheap, may, by want of "durability," and even with a high illuminating power, be very expensive to the consumer.

Photometrical Studies.—M. Elster.—This paper, and the following—

Purification of Coal-Gas—M. Buhe—are excellent treatises on the subjects, but, unfortunately, too lengthy to admit of any useful abstraction. As regards the purification of gas, it is quite clear, from the manner in which this subject has been taken up abroad that it deserves deeper looking into than is generally done at gas-works.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, May, 1869.

This number does not contain any papers at all relating to chemistry or sciences allied thereto.

June, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Preparation of Silicic Acid in Crystalline Shape by the Dry Way.—M. Rose.—The paper is identical with that which appeared on this subject, written by the same author, in the *Berichte der Deutschen Chemischen Gesellschaft*, No. 14, 1869, from which it has been abstracted.

Relation of Chloral and Trichloracetic Acid to the Animal Organism.—Dr. Liebreich.—This paper relates a series of physiological experiments aided by chemical reactions. It appears that hydrate of chloral may become a very useful and safe anæsthetic.

Emission and Absorption of Heat Radiated at Lower Temperatures.—M. Magnus.—The author states—"Different bodies heated to 150° emit, by radiation, different kinds of heat; some bodies only emit one kind of heat. Rock salt belongs to those substances which, if it is quite pure, emit different kinds of heat. The author then enters into discussions on diathermancy, and the power of absorption for certain rays of heat; but the paper is too concisely written to admit of any further useful abstraction.

Moniteur Scientifique, October, 1869.

This number opens with a short paper on—

Artificial Alizarine.—M. Kœchlin.—To this paper is added a set of printed-calico patterns, dyed in five different species of colours, viz., black, puce, scarlet, pink, and violet, respectively produced by the artificial alizarine of Messrs. Meister and Lucius, as made by them at Hoechst, near Frankfort—madder, garancine, alizarine from madder, and purpurine from madder, both sublimed. From the author's paper, it appears that the substance made by the firm just alluded to is neither artificial alizarine nor purpurine, but a new compound, superior to both these substances. Alizarine, indigotine, and luteoline are correlated by the property of being crystallisable by sublimation. Purpurine does not yield solid colours until after it has been sublimed.

Test for Detecting Very Minute Quantities of Iodine.—M. Alfraise.—Take water, 100 grms., starch, 1 grm., nitrite of potassa, 1 grm.; boil this mixture during five minutes, and, after cooling, pour it in a bottle, wherein it keeps for years without deterioration. When required for use, take 10 c.c., add one single drop of hydrochloric acid. Take as much as a pin's head in size of the dry salt to be tested for iodine, place it in a clean porcelain capsule, and add one drop of the test-fluid last mentioned. When no iodine is present, no coloration ensues; but the least trace of iodine gives rise to the formation of a well-defined blue colour. The liquid test-fluid, after addition of HCl, keeps quite well in a properly-stoppered small bottle.

NOTES AND QUERIES.

Carbonic Acid.—Can any of your readers give me some practical information respecting the manufacture of the above by Harrison Blair's process, viz., the passage of common or superheated steam over red-hot limestone enclosed in fire-clay retorts?—CO_2.

Spectrum of Sirius.—In the hydrogen line, F, of the spectrum of Sirius, that line is not exactly coincident with the solar line, F. If, then, this deviation exists in that line, should not the like condition occur with respect to the lines of sodium, iron, &c., which I do not understand Mr. Huggins to state?—W. P.

Magic Lantern Light.—I require a powerful light to show to an audience the microscopic image enlarged upon a white sheet in a darkened room, and would take it kind if any of your readers could tell me—(1) Will the magnesium lamp do (the room is a comparatively small one); (2) whether is Solomon's or Larkin's powder-lamp best, and (3) where can I obtain or hear of Larkin's lamp (mentioned in the CHEMICAL NEWS, vol. xv., p. 323)?—C. HUNTER.

Detection of Artificially-Coloured Red Wine.—Dr. Wittstein.—The author states that he was desirous to try whether the statement of M. Facen that peroxide of manganese has the property of decolorising naturally red-coloured wine, but leaving the colour of artificially red-coloured wines untouched when, after having been simply for some time in contact with the peroxide, it is filtered off from that material again. The author had some genuine good red wine, the produce of his own vineyard, and also experimented upon some samples obtained from wholesale houses: and he found that, after treatment with peroxide of manganese, all these samples lost their red colour; and, according to Facen's statement, there might be assumed that none of these samples of wine were artificially coloured. The author then added to a genuine red wine about 1-25th part of its weight of mallow flowers (Flores Malvæ arboreæ), which are largely used for colouring wine; and, at the same time, the author repeated this experiment with a very faintly straw-yellow-coloured white wine, obtaining thus beautifully red-coloured wines. On shaking these up with peroxide of manganese, the artificially-coloured samples were, however, found as readily decoloured after filtration as the genuine red wines had been; therefore M. Facen's test does not hold good.—*Polytechnisches Centralblatt*.

TO CORRESPONDENTS.

Ferrum.—Send us sample, with full particulars, as we know o several who use it.

Amatta.—You will find particulars for making sympathetic ink in Cooley's "Cyclopædia of Practical Receipts."

BOOKS RECEIVED.

Elements of Chemistry, Theoretical and Practical. By W. A. Miller, M.D., D.C.L., L.L.D., V.P.R.S., &c., fourth edition, with additions. Part III. Organic Chemistry. London: Longmans.

The Ship-Captain's Medical Guide. Compiled by Harry Leach. 3rd Edition. London: Simpkin, Marshall, and Co.

THE CHEMICAL NEWS.

Vol. XX. No. 517.

ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

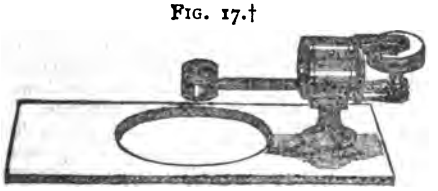
(Continued from p. 182.)

The processes connected with the preparation and preservation of microscopical objects have always occupied a considerable space in nearly every work on the use of the instrument. The subject is one of general interest, and the importance of being able to preserve specimens for future reference can scarcely be overrated.

The simplest of these processes, and also the oldest, is that known as "dry-mounting."

The objects suitable for mounting dry are those which can be preserved in air and are capable of being dried without injury to their structure. The ways of mounting are extremely numerous, and are principally means of protection from the great enemies of all natural history preparations—damp and dust. One of the oldest ways of mounting objects was upon discs punched from a compound sheet of card and wash-leather, through which a pin was run for convenience of holding in the stage forceps and keeping in a cork-bottomed drawer. This plan of mounting was abandoned when the lieberkuhn fell into disuse, but it has since been revived in a new form by the late Richard Beck, who invented a very ingenious instrument for holding the small

Fig. 17.†



discs of metal and turning them into any required position. This is an extremely useful piece of apparatus, as it is often required to turn an object into several positions for the thorough examination of its structure. So perfectly is this accomplished, that five out of the six sides of a cube may be examined by means of the revolving disc-holder. This instrument has supplied a want created by the introduction of the binocular microscope, as the greater focal depth and stereoscopic effect given by it has rendered advantageous frequent changes of the position of objects, for which this contrivance most effectually provides. For the keeping of the discs from the influence of dust and damp, he contrived a close-fitting screw-box, having suitable arrangements for the reception of twenty-four discs.

Great use has also been made by some observers of open cells. These consist of a hole bored in a 3 × 1 slide of wood, with a piece of card-board glued to the bottom, the objects being fastened with a little gum. This answers very well with objects not liable to injury from exposure, such as shells; but, for most purposes, it is necessary to close up the object, and this, in many instances, is done in a manner very detrimental to its preservation. Wherever paper and paste or gum are used, various fungi and confervæ are nearly sure to make their appearance, unless special precautions, such as saturating the paper with, and mixing in the gum, a small quantity of corrosive sublimate. The microscopical fungi are doubtless interesting plants, but, when they grow over valuable preparations, we feel them to be a nuisance, and decidedly in the way.

Some microscopists, avoiding the use of paste, gum, and paper for securing the cover to the slide, have made use of varnishes of several kinds These generally have the defect, if thin, of running in between the glass and cover and spoiling the object, and, if thickened with a solid substance, such as lamp-black or vermillion, of becoming porous after a time. Some of the fluid medium of the varnish, also, is liable, in drying, to rise in vapour within the cell, and condense on the cover, interfering with the distinct view of the object. The vapour of turpentine or naphtha, however, is in no way otherwise detrimental, as it tends rather to the preservation than the destruction of tissues.

The electrical cement previously described (Chemical News, vol. xx., p. 181) is free from this defect, and furnishes a means of rapidly mounting objects either with or without a cell. If the object is very thin and flat, it may be placed upon a slide, and a thin glass cover put over it. Both having been carefully cleaned, one of the spring clips made of wire and cork (which are to be procured of most opticians) can be used to hold the cover in place while the cement is being run round it with the little brass bit. The bit should not be made too hot, or it will not hold the cement. After the cover has been fastened down, the rough cement can be smoothed by passing over it a clean bit, heated rather more than is required for laying on the cement. The bit is easily cleaned by wiping while hot upon a piece of blotting-paper. The first attempts, no doubt, will be far from elegant in appearance; but, after a little practice, great neatness may be attained. This process is also available for attaching the cover to cells of metal or glass, which must be used with dry-mounted objects whenever their thickness is such as to require it. This mode was formerly much employed, but was abandoned on account of the brittleness of the cement. This may be remedied by varnishing, when the cement has become hard, with gold-size, which is remarkable for the tenacity with which it adheres to glass and its toughness and non-liability to crack. Respecting the properties of this varnish, more will be said in the chapters relating to fluid-mounting. This system of compound cementing answers perfectly; the electrical cement having, in the first instance, no tendency to run in, and the gold-size effectually keeping it from separating from the glass. If the natural red colour of the electrical cement is objected to, a black finish can best be obtained by the use of lamp-black as prepared for water-colour painting. The best form is that in tubes. A little of this is pressed from the tube, and, if too thick, a small quantity of water added. With this the varnished surface is thickly painted, and, when dry, a few coats of gold-size will

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

† This, with several other woodcuts, have been kindly lent by Messrs. R. and J. Beck, of Cornhill.

keep it from being washed off. The result is a dense, lustrous black, very superior in effect and durability to that produced by a black varnish. This finish is equally available for fluid and balsam mountings.

If the object cannot be kept in its place by the pressure of the cover glass, it will require fastening. If the object will bear a slight amount of heat, a small spot of electrical cement may be placed on the glass, melted by holding over a lamp, and, while soft, the object fixed. Or the thick varnish composed of shellac and wood-naphtha, sold at most varnish-shops as liquid glue or "patent knotting varnish," will be found useful for this and other purposes to be mentioned hereafter. Care must be taken to allow the naphtha time to evaporate, or its vapour will obscure the cover. While this drying is taking place, the slide may be turned face downwards over a large pill-box, or the cover put on, and kept in place with a spot or two of electrical cement, deferring the completion until the varnish has dried.

It is not necessary to employ any kind of black background for opaque objects, the best background being that of the dark-well beneath the stage, formed by bringing round that part of the diaphragm-plate which has no hole, and so closing up the aperture. If a black patch is used, it prevents advantage being taken of various kinds of illumination from beneath, which are often of great service, while the mounting on clear glass is in no way detrimental to the view of an object lighted from above.

It is necessary that the object to be mounted should be perfectly dry before it is placed in the cell, otherwise moisture will, sooner or later, make itself apparent.

Most objects can be dried by the application of a moderate heat. If wrapped up in a piece of paper, and placed inside the fender, in an hour or so they will be found to be effectually dried. A Seidlitz-powder box answers extremely well for this kind of drying: it can be still more effectually accomplished by means of the well-known hot-water oven.

There are cases, however, where heat is inadmissible, especially with delicate tissues. The desiccation of these is best accomplished in a vacuum. The substance to be dried is placed under the receiver of an air-pump; the air is exhausted, and, under these conditions, it will give off vapour at a much lower temperature than under ordinary atmospheric pressure. It is only necessary to provide some means of absorbing the watery vapour as fast as it is given off—such as concentrated sulphuric acid or dry lime.

Another, and very effectual mode of drying delicate tissues without heat, is the process described in the CHEMICAL NEWS (vol. xiii., p. 122), translated from *Zeitsch. fur Anal. Chemie.* This process, which is quite new so far as its application to microscopical purposes is concerned, consists in immersing the substance to be dried in ether in the presence of dry chloride of calcium. The apparatus employed is simple, consisting of a wide-mouthed stoppered-bottle, at the bottom of which is placed some chloride of calcium. A slice from the bowl of a tobacco-pipe forms a support for a Berlin crucible and cover, in which the substance to be dried is placed. The whole is then covered with ether (the methylated answers very well for the purpose), and the mouth of the bottle closed. The ether absorbs water from the tissue, which is again absorbed by the chloride of calcium, and the process goes on without attention until the chloride of calcium ceases to absorb. The results, as far as at present ascertained, have been very satisfactory. Cellular tissue (fresh potatoe) has been dried without any contraction. Flies' heads have contracted less than by drying in air; the eyes were in very perfect condition, and gave good results upon a section being cut; the striation on the muscular fibre was perfectly preserved. A small spider, treated by this process, was dried without any shrinking of the abdomen. Those substances which are injuriously acted upon by ether cannot, of course, be dried by this process; but it is evidently a very valuable addition to the microscopist's resources.

When the object is removed from the drying apparatus, the ether dries off in a few seconds. If it is required to preserve the object in balsam, it can either be mounted at once, wet, with ether, or transferred to benzole or turpentine.

(To be continued.)

A NEW AND ECONOMICAL METHOD FOR EFFECTING THE EXTRICATION AND CONDENSATION OF AMMONIA FROM GAS LIQUOR FOR PURPOSES OF CHEAP CARRIAGE, AND FOR FACILITATING THE MANUFACTURE OF AMMONIACAL SALTS.*

By FREDERICK BRABY, F.G.S.

(Concluded from p. 184).

The principles already indicated may, perhaps, be illustrated with advantage by a brief description of a working-plant actually constructed at Deptford for the purpose of extracting ammonia. An excavation has been made in which is sunk a reservoir for containing the gas liquor, and having the following dimensions:—namely, 35 feet long, 7 feet wide, and 6 feet deep. The bottom is formed of 1 foot of concrete, two courses of bricks, and of two courses of red flat tiles; the sides are of 14-inch brick-work, two courses with tiles in conjunction with concrete.

The wrought-iron still is set in brick-work, so that flame may play more than half round its external surface. It is 30 feet long by 6 feet in diameter. About 4000 gallons of gas liquor are pumped into it from the reservoir for the purpose of being operated upon.

Heat is applied by means of a fire underneath, but a coil of hot air or steam pipes placed in the interior of the still or boiler would be equally efficacious. Two cast-iron 3-inch air-pipes, which are attached to the ammonia generator, extend along its whole length, and are situated one on either side, and nearly at the bottom. They are perforated with holes increasing in size as they extend from the inlet. Into these pipes, and from them into the gas liquor, is driven atmospheric air by means of a pair of cast-iron force-pumps. These are 20 inches in diameter, 1 foot 8 inches stroke, with rods and slings, wrought-iron connecting rod and crank, and a cast-iron beam 6 feet long. On the entry of the streams of air they are caught and agitated by the twelve iron fans of a stirrer, making about 80 revolutions per minute.

The air, together with the lime and the various constituents of the gas liquor (viz., water, ammonia, carbonic dioxide, sulphuretted hydrogen, sulpho-cyanides, &c.) are thus brought continuously into intimate contact. The air loaded with the volatile alkali which has become eliminated from the solution passes upwards into the steam chest and through a branch pipe into the purifier or washer. This is a small wooden vessel of the capacity of 350 gallons, containing lime and being about one-third full

* Read before the British Association, Exeter meeting, Section B.

of water. It has a tight head and a stout perforated elm false bottom, the holes being concentric and increasing in number and dimension as they radiate from the inlet, which is brought below the false bottom.

This purifying vessel is furnished with a small agitator having two blades, one revolving above and the other below the false bottom. There are two trial or test taps at appropriate heights, to test for gas or for water, and there is also a pipe sealed at one end, rather less than half way from the bottom, for the purpose of leading away any excess of liquid that may accumulate owing to the condensation of aqueous vapour which may pass over with the volatile alkali. There is a long straight tube or safety pipe from the washer, and the bent pipe from the ammonia generator is also provided with a safety valve and a vacuum valve. In the washer the ammonia is deprived of any remaining hydrosulphuric acid or other impurity that may have escaped being fixed in the generator. About half a bushel of finely sifted slaked chalk lime is found to be a suitable charge for the washer, and when this becomes saturated or impure, it is renewed by means of a pipe and tap placed at the bottom of the vessel. The washer being a close vessel soon becomes full of air and gas, which are forced by the pressure through a pipe opening into the top and leading to a coil or worm placed in a cold water cistern, and terminating in a deep close vessel about one-third full of pure cold water, which has been condensed from the waste steam from the engine. A portion of the ammonia becomes absorbed by the water, but the residue, together with all the air, after bubbling up through the liquid, is conducted by a bent pipe to nearly the bottom of a second similar receiver, and thence in the same way to a third, but which is opened at the top,

The air, having fulfilled its function, is now permitted to escape into the atmosphere, the whole of the ammonia having, however, been arrested.

This last receiver, instead of water, contains a strong solution of chloride of iron, which being denser and possessing a higher specific gravity than water, offers a greater pressure and resistance to the passage of the gas. The iron salt is, of course, decomposed, with formation of muriate of ammonia in solution, with deposition of a green mud containing sesquioxide of iron, which, after having been calcined, is found to constitute an excellent pigment for rough iron or wood-work.

After the whole of the ammonia has been extracted from the gas liquor, the contents of the still are run off into a draining pit, from which the clear solution finds its way into the sewers, and the solid inodorous lime compounds may be carted away.

This draining pit is constructed of 1¼ inch deal boards together with sand and brick-work. It is 4 feet 9 inches wide, 5 feet 4 inches deep, and 10 feet long. There are fillets whereon to rest three perforated shelves or platforms. The bottom is formed of perforated deals with 6 inches of sand, also with gravel, and cement. There are channels and small drain pipes leading into a large central earthenware pipe, and from thence into the sewer. The sharp sand, &c., under the perforated boards can be removed at will, and be replaced by fresh materials whenever required.

Care must be taken that the large pipe from the boiler to the washer be sufficiently high to guard against any back pressure. The vacuum valve opens and admits air when the fire of the still is withdrawn and the steam becomes condensed.

In order to ascertain the exact state of the contents of the boiler at any required height, and to avoid tapping the upper portion of the boiler at too many places, the following simple contrivance is adopted:—There is one tap at the lower end, to which is attached a short pipe inside the still working easily on an elbow. To this pipe is connected a copper wire having its outlet just above the external surface of the boiler, and by which wire the short pipe may have its orifice presented at any required height, at which it is desired to ascertain the state of the contents of the vessel. For instance, supposing the fire to be withdrawn, and the agitators to be quiescent, if the end of the tube were pulled up by the wire and the tap opened, a clear liquid would issue, which could be tested in order to ascertain whether the whole of the ammoniacal gas had been removed. On the other hand, if the short tube were allowed to lay along the bottom of the still, the opened cock would allow the green sulphocalcareous mud to escape. It is stated in Dr. Miller's "Elements of Chemistry" that, at a temperature of 32°, water takes up about 1050 times its volume of ammonia; at 59°, 727 times, and at 78°, 586 times its volume. Water saturated with ammonia at 60° contains more than one-third of its weight of the gas, increasing in bulk from 1·0 to 1·5, and becoming specifically lighter.

Hence the receiver should be not more than one-third or one-half full of water to allow for the increase in bulk caused by the solution of the ammonia.

In July, 1867, valuable papers upon the utilisation of the waste products of the manufacture of coal gas were read before that important body, the British Association of Gas Managers, by two of our first authorities on this subject, Dr. Letheby and W. Esson, Esq. Dr. Letheby declares that it is so manifestly of the greatest importance that the liquor should be sent away to the gas works as strong as possible; it ought, in fact, never to be under 6° Twaddle, or of less than 12 ounces strength, and with proper condensation and judicious washing there should be from 29 to 30 gallons of such liquor produced from every ton of coals. The price in London is 2s. per butt, 8-oz., with an increase of 4d. per oz. on every additional ounce of acid strength. Below 3° of Twaddle or 5 ounces of acid it does not pay for working, whereas at 10° or 11° of Twaddle it is a valuable product. Both Dr. Letheby and Mr. Esson emphatically insist upon the importance of the strength of the ammoniacal liquor. So rapidly does the commercial value augment, in relation to its concentration that, whereas a butt of 108 gallons of gas liquor is worth 4s., the same quantity of caustic ammonia of specific gravity 0·900 is worth from £15 to £20. A lower strength of gas liquor than 6-ounce has not hitherto been thought worth working, but one advantage in Braby's system of extraction and concentration consists in the fact that a high strength is not indispensable. Even 2 ounces would in practice yield a profit.

As an evidence of the importance of an increased supply of ammonia and of its large demand, it may be mentioned that a firm with which the writer is connected recently offered 4s. per butt of 6-ounce liquor, and yet was unable to obtain a supply, showing that the value has doubled in the short space of two years. Mr. Esson describes an economical arrangement for the extraction of ammonia from gas liquor with the assistance of steam, and by an apparatus similar to a Coffey's still, but which is subject to the disadvantage that the noxious gas (sulphuretted hydrogen) is not simultaneously fixed or disposed of, and that at least 15 per cent of ammonia is left in the liquor, which has afterwards to undergo the supplementary process of distillation with lime. The present ordinary method of making liquor ammonia is, as far as I am acquainted, from sulphate or muriate of ammonia, which is itself obtained from gas water. By Braby's process, liquor ammonia may be obtained much more quickly and economically from gas-liquor direct.

There are many gas-works where ammoniacal salts are now manufactured; but it is suggested that, in new works, or at those where the gas-liquor is not at present utilised, it would be preferable, in the event of the adoption of the principle herein advocated, that the ammonia, after concentration, should be sent to the sulphuric or muriatic acid works, rather than that the acids should be sent to the gas-works. In metallurgy, it is found more advantageous to transport the calcined or partly-prepared ores to the coal districts for smelting, rather than to take the fuel to the mines.

Barges fitted with tanks ordinarily employed in the conveyance of gas-liquor contain from 3000 to 8000

gallons. A land journey of 12 miles with two horses for a load of 500 gallons in a tank-van now costs £1. By rail, the cost of freight is 1d. per ton per mile.

The advantages of the above-described system may be summed up as effecting a considerable economy in labour, time, and occupation of plant, together with the facility of extracting the whole of the ammonia from the gas-liquor in a pure condition. A manufactory, previously consuming 10,000 gallons of gas-liquor per week, may now utilise 24,000 gallons, and at about half the expense of fuel of that formerly incurred.

The great interest of this subject in a chemical point of view, its high importance to the metallurgist and manufacturer, and the increasing value of ammonia to the farmer (with whom it is almost another name for fertility and abundance), must constitute my apology for having engaged so much valuable time in its consideration.

A CHEMICAL METHOD OF TREATING THE EXCRETA OF TOWNS.*

By EDWARD C. C. STANFORD, F.C.S.

THIS paper is intended as a continuation of two former papers read before the Glasgow Philosophical Society, and published together in the CHEMICAL NEWS, under the title of "A Chemist's View of the Sewage Question."

In these papers, I have endeavoured to show that the water-closet system of disposing of human excreta, unless it undergoes some great modification, can never be regarded as the perfect system of the future. I have strongly urged the general adoption of the dry-closet, as avoiding all the great evils which are apparently inseparable from the use of water as a vehicle; and pointed out the use of charcoal, by which its application to towns and cities is simple and easy. Since these papers were published, further experiments have been made, which strongly confirm the opinions already advanced, and form the subject of this paper.

Amongst other objections to the use of water as a carrier, I have specified—

1. The enormous cost of the works required, in proportion to the small amount of noxious material to be removed.

2. The large annual outlay required to keep the closets in order. Experience, in large cities, has shown that, on this account, these closets are quite unsuitable for the dwellings of the poor.

3. The enormous amount of water employed (estimated at 365 times the weight of the excreta), where, as in many towns, there is much difficulty in obtaining it.

4. That it results in a subterranean flood of filthy water, which must flow somewhere; and, wherever it flows, it pollutes the region, thus disseminating and distributing the evil.

5. This material, worth about 30s. per ton, has its value reduced, by dilution, to 1d. per ton, which it is impossible, by any known chemical method, to extract with profit.

6. The large generation of noxious gases in the sewers, which constantly escape into our streets and houses.

In reference to the latter, Dr. Gairdner speaks strongly of almost all sewers, as "diffusing poison upwards and downwards," and too often "carrying backwards, into the very heart of the dwelling, the reflux gases, the produce of the decomposition of the impurities of a whole neighbourhood."

Dr. Fergus characterises the sewers as "a gigantic laboratory under our dwellings," from which noxious gases escape, by gully holes into our streets and pipes into our houses.

He has furnished me with a number of extracts from eminent medical authorities, which conclusively show the highly dangerous character of the miasma occasioned by the infiltration of sewage water and the evolution of sewer gas.

Of these I shall only make two quotations, which should be sufficient to convince any one of the important bearing of this question on the national health:—

EXTRACT No. I.

Mr. SIMMS'S *Second Report* (1860) *of* Dr. GREENHORN'S *Investigations in Several Towns in England.*

Pages 59 and 60.—"*Diarrhœal diseases* are increasing in this country; they vary, in different districts, from 4 to 663 per 100,000 persons. If the diarrhœal death-rate of England generally were only ten times the minimum diarrhœal death-rate, there would be an annual saving in England of nearly 20,000 lives."

"In the districts which suffer the high diarrhœal death-rates, the population either breathes or drinks a large amount of putrefying animal refuse."

Page 61.—"If the diarrhœal death-rate of England is reduced to that which prevails among the healthier parts of the population, typhoid fever (now, probably, the cause of at least 15,000 annual deaths) will be reduced in more than equal measure; and in proportion as infantile diarrhœa is reduced, the convulsive disorders and respiratory inflammations of infancy (which now cause fully 60,000 annual deaths) will also show a large, if not equal, reduction of death-rate."

Page 64.—"The excess of mortality has, in all cases, been coincident with one or other of two local circumstances—(*a*). *The tainting of the atmosphere with the products of organic decomposition, especially of human excrement;* or (*b*), *the habitual drinking of impure water.*"

EXTRACT No. II.

From Mr. SIMON'S *Ninth Report to the Privy Council.*

Pages 32, 33, and 34.—"*Cholera* derives all its epidemic destructiveness from filth, and especially from excremental uncleanliness."

"It cannot be too distinctly understood that the person who contracts cholera in this country is, *ipso facto*, demonstrated with almost absolute certainty to have been exposed to excremental pollution; that what gave him cholera was, mediately or immediately, cholera contagion discharged from another's bowels; that, in short, this diffusion of cholera among us depends entirely on the numberless filthy facilities which are let exist, and especially in our larger towns, for the fouling of earth, and air, and water, and thus, secondarily, for the infection of man with whatever contagion may be contained in the miscellaneous outflowings of the population. Excrement sodden earth, excrement reeking air, excrement tainted water; these are, for us, the causes of cholera. Cholera ravaging here at long intervals is not Nature's only retribution for our neglect in such matters as are in question. *Typhoid fever and much endemic diarrhœa are, as I have often reported, incessant witnesses to the same deleterious influence. Typhoid fever, which annually kills some* 15,000 *to* 20,000 *of our population; and diarrhœa, which kills many thousands besides.*"

Dr. Fergus has drawn attention to a remarkable but very common and fruitful cause of the escape of sewer gas into houses. He frequently noticed, when attending patients suffering from gastric fever, a peculiarly sickly and offensive odour, and in all cases traced it to the leaden syphons and soil-pipes of the water-closet. On examination, these were generally found to be perforated with holes, sometimes of considerable size, through which the sewer gases freely escaped into the house. The evil exists to an extent which will scarcely be credited by those who have not specially investigated the subject. A long length of soil-pipe will often be found bulged outwards in little swellings, each of which, sooner or later, open, and present apertures for the escape of sewer gas.

* Read before the British Association, Exeter Meeting, Section B.

If the pipe be laid, as it often is, under a bed-room floor, this may go on for years, until at last the pipe is taken up in a perfect honeycomb of deterioration; and we may pretty safely predict the sanitary condition of that bed-room and of its occupants. I have been informed by plumbers that it occurs most quickly where chloride of lime has been used; but the necessity for the use of this shows that the evil had existed before its application. The pipe becomes covered in the interior with a whitish-brown powder, of which four specimens were examined; the composition is shown below:—

	I.	II.	III.	IV.
Carbonate of lead	2·70	86·00	91·00	92·90
Carbonate of lime	80·63	2·50	2·10	2·90
Water	0·45	1·20	1·00	0·50
Lead insoluble as oxide ..	—	3·50	1·50	1·45
Silica	1·35	2·80	1·00	1·60
Organic matter	14·87	4·00	3·40	0·65
	100·00	100·00	100·00	100·00

The lead put down as insoluble is combined, apparently, with a kind of fatty acid, represented as organic matter. In No. 1, chloride of lime has evidently been recently used. The pipes are all taken from different closets, and arranged in an increasing order of deterioration. The action is probably caused by the carbonic acid, aided by the other gases of decomposition, and the fatty matter of the excreta producing carbonate of lead under somewhat similar conditions to those which obtain in its manufacture on the large scale; the carbonate of lime being derived from the solid excreta. This view requires confirmation; but one fact is obvious (and it is sufficient to show that the water-closet has been introduced before we have studied its effects)—that leaden pipes so much condemned for carriage of water for drinking purposes are even more unsuitable for house drainage; and the reason given explains, to a certain extent, what is generally admitted—that the common earthenware syphon forms the cleanest water-closet.

None of the disadvantages enumerated attend the use of the dry-closet; still less can any of these gigantic malaria evils result from its general adoption. It meets every sanitary requirement, which, after all, is the main desideratum. Moreover, its machinery is simple and inexpensive. It effects at once a great saving of water; and it enables us to secure the whole of the value of the excreta. I have pointed out the only objections which can be urged against its application in large cities to be, when dry earth is used; the large amount required (three and a half times the weight of the excreta), the difficulty of obtaining such a supply, and the large cartage necessary: three and a half times the weight to be removed into the city, and four and a half times the weight to be carried out.

Now, by using charcoal, these objections are entirely removed; for it only requires one-fourth the quantity as compared to earth, and, by re-burning the charcoal, the supply is provided from the excreta itself; and the cartage is reduced to the weight of the material carried into the city, and twice its weight carried out. The quantity per diem for a population of 500,000 is calculated at 385 tons in, and 770 tons out; a quantity about the same in Glasgow as the city ashes.

Moreover, charcoal has other advantages over earth. It is a powerful deodoriser, and its employment guarantees a perfect immunity from odour quite unattainable by any water-closet; and it blackens and conceals the excreta so perfectly that no one seeing the product from the closets for the first time would have the least notion from its appearance what it was. As, also, the dust would always be sifted out for sale as manure, the charcoal used in the closets would always be of proper size, and no dust could be projected in the working of the closet. Such a closet could be kept in every bed-room without the possibility of becoming a nuisance, if only attended to; but, in houses constructed for the purposes, the closets on the several floors would be over one another, and the product from each fall through a 12-inch pipe to a small cesspit below the house, and this need only be emptied once a year. The small size of this pit may be imagined when it is mentioned that 1 cwt. of charcoal per month will be sufficient for each closet if used by six persons daily, and one cart load per annum will empty the pit.

Use of Charcoal in Latrines.—I have shown, in a former paper, how the use of seaweed charcoal in latrines effects its composition, by converting the carbonate of lime it contains into phosphate. The results published were from experiments with ten, twenty, fifty, and one hundred times its weight of urine evaporated down. I found that, though in all cases there appeared to be no appreciable loss of ammonia in drying, when the last product was re-burned alone, only half the nitrogen came over as ammonia, though the whole was obtained by soda lime. As, however, I propose for latrines the charcoal should be used ten times before re-burning, I have undertaken a complete series of experiments, the results of which are given in Tables A, B, and C, showing the composition of the chars after each re-burning, up to ten re-burnings and one hundred uses. The results are as regular as can be expected from the variable composition of the substance operated on. It will be seen that the residual chars rise, after five or six re-burnings, to about 25 per cent phosphate of lime, while the carbonate is reduced to 2 per cent. After having attained this composition at which it becomes regular, it would be advisable to add a certain proportion of fresh seaweed char, to prevent the phosphoric acid remaining soluble, of which a trace now appears, and to secure a regular supply of a good sugar-refiners' charcoal, which would add a considerable value to it. In any case, the phosphate of lime thus gradually deposited is quite equal to a soluble phosphate for agriculture on account of its finely divided condition. The average yield of ammonia by simple re-burning is about equal to the calculated amount, and shows clearly that neither in the drying nor in the distillation has any been lost. The total yield is 3·16 per cent on the char, or 31·6 per cent for each re-burning. The total increase of char is 183 per cent, or 18·3 per cent for each re-burning.

The density of the char has increased 131 per cent in the ten re-burnings, the increase being mostly in the first five re-burnings. The ammonia only was estimated in the destructive distillation. The increments of potash and phosphoric acid are pretty regular, that of sulphuric acid remarkably irregular. The commercial result of this process for latrines would be as follows:—Supposing the char sold as a manure after ten uses, 1 ton would produce, allowing 15 per cent for moisture, 30 cwts. of manure, containing nitrogen equal to 20 per cent sulphate ammonia, 7 per cent phosphate lime, and 5 per cent sulphate potash, and worth at least £5 per ton, or equal £7 10s., whilst it would have cost £2 for the char, 30s. for cartage, reckoned at 10 tons carted in and 20 tons carted out at 1s. per ton, or a profit of 8os. on each ton of char used. If, again, the char be used fifty times, and re-burned five times, its cost will be increased by cartage to £9 10s., and, by five re-burnings at 3s. 6d., to £10 7s. 6d., and in quantity, allowing 11 per cent for moisture, to 2 tons, the cost being thus £5 3s. 9d. per ton, and its value, containing 12 per cent phosphate lime, reckoned as soluble, and 15 per cent sulphate of potash, is £5 per ton, in addition to which nearly 30 cwts. of sulphate of ammonia are yielded in the five re-burnings, worth, at 16s. per cwt., the sum of £24 less the cost of acid. If, however, the char be as good a sugar refiner as I suppose, its value will be much above that stated. In this case, however, the char would have to be washed, and the amount would be less by the amount of soluble matter it contains from which the potash could be separated. It would be easy, of course, to increase the soluble phosphate for some crops by the addition of mineral phosphate rendered soluble.

Use of Charcoal in Closets.—The experiments, the results of which are given in Tables D and E, were made with one of Smith's self-acting dry-closets, used by several lads.

No. 1 was distilled wet, Nos. 2 and 3 dry. After this, the charges were dried, and returned to the closet, and used again before being re-burnt. Nos. 8, 9, and 10 are complete analyses; and what is deficient in the others is calculated from these. A portion of the ammonia comes over combined with acetic acid, which is separately shown, and also the acetic acid as acetate of lime. The average results per deposit and per cent of wet and dry excreta are also shown. The composition of several of the resulting chars, and the increase per cent of the several ingredients, are shown in Table E. After No. 3, the compositions are pretty similar; and this may be taken, therefore, to be the char from excreta. The char commenced with was only 3 lbs., or 48 ozs., to which 18 ozs. were afterwards added, the total amount employed being 66 ozs. At the end of the experiment, it amounted to 123 ozs., 57 ozs. being derived from the excreta; and yet this small original stock served 181 uses of the closet and absorbed 808 ozs. of wet excreta, having been dried and re-used seventeen times, and re-burnt ten times. It increased about 66 per cent in density, then remaining constant, but was in every respect better adapted for the closet, and improved by the treatment, the charge being still under 8 ozs. at the end of the experiment. The distillation yielded over 38 ozs. of sulphate of ammonia, or nearly 7 per cent of the wet excreta. I propose that the mixture should be dried and re-used five times before being re-burnt: this has not been done in these experiments, as I was impatient for results. Where this is done, a considerable quantity of gas is given off in the distillation, and, from the large amount of fatty matter, it possesses considerable illuminating power. This fatty

TABLE A.

Residual Chars.—Composition per cent.

	Ordinary Char.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Water	10·00	—	—	—	—	—	—	—	—	—	—
Soluble salts	0·60	9·00	17·60	27·00	36·20	41·80	49·20	51·20	54·80	56·80	59·20
Insoluble	89·40	91·00	82·40	73·00	63·80	58·20	50·80	48·80	45·20	43·20	40·80
Soluble.											
Chlorine =	—	4·87	8·56	13·32	16·80	19·32	23·31	26·46	28·56	29·40	31·08
Chloride of sodium	—	8·11	14·26	22·17	28·00	32·20	38·83	44·00	47·60	49·00	51·80
Sulphuric acid	0·30	0·51	1·02	1·37	3·50	3·70	4·11	2·00	2·05	2·22	0·68
Phosphoric acid	—	—	—	—	—	—	—	—	trace	trace	trace
Potash	0·30	2·30	4·20	4·60	7·69	8·07	10·76	10·96	11·15	11·73	12·40
Insoluble.											
Carbon	54·40	40·00	40·60	35·80	32·20	33·20	26·20	26·00	23·40	23·40	23·40
Silica	9·10	12·40	12·40	11·20	8·80	6·20	6·20	5·60	5·20	4·40	3·20
Phosphate of lime	4·80	6·60	8·40	10·20	11·60	12·00	12·20	11·60	11·40	10·40	10·50
Carbonate of lime	17·40	24·20	15·60	11·60	7·40	3·60	2·80	1·20	0·40	0·40	0·90
Carbonate of magnesia	3·10	5·80	4·40	3·00	3·00	3·00	2·40	2·00	1·60	1·40	1·10
Specific gravity (relative)	1000	1254	1636	1659	1744	1822	1915	1995	2274	2294	2313

Washed Chars—Dry.

	Ordinary Char.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Carbon	61·12	44·94	49·87	49·71	51·11	57·24	52·40	55·31	54·41	58·50	59·24
Phosphate of lime	5·39	7·41	10·31	14·16	18·41	20·68	24·50	24·68	26·51	26·00	26·58
Carbonate of lime	19·55	27·19	19·16	16·11	11·74	6·20	5·60	2·54	0·93	1·00	2·28
Carbonate of magnesia	3·48	6·51	5·40	4·02	4·76	5·17	4·80	4·25	3·71	3·50	2·88

TABLE B.

Total Increase per cent on Original Char Used.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Dry solid matter	33·25	79·55	126·45	166·45	217·65	249·65	295·65	347·69	391·59	455·09
Char	6·20	23·08	44·71	59·65	80·61	98·48	116·88	136·68	154·24	183·40
Sulphate of ammonia	30·07	69·02	89·70	117·28	147·86	178·30	210·01	246·26	276·91	316·26

Residual Chars.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Water	—	—	—	—	—	—	—	—	—	—
Soluble salts	8·14	21·05	38·28	56·96	74·64	96·81	109·99	128·73	143·67	166·93
Insoluble	5·36	12·15	14·28	12·04	15·36	11·18	16·00	17·21	20·33	26·06
Soluble.										
Chlorine =	5·16	10·53	19·18	26·71	34·77	46·15	57·03	67·40	74·58	88·95
Chloride of sodium	8·59	17·53	31·92	40·52	57·96	76·88	95·04	112·33	124·46	146·59
Sulphuric acid	0·24	0·95	1·67	5·26	6·36	7·84	4·02	4·54	5·34	1·62
Phosphoric acid	—	—	—	—	—	—	—	trace	trace	trace
Potash	2·13	4·86	6·32	11·93	14·22	21·01	23·37	26·01	29·49	34·79
Insoluble.										
Carbon	*12·00	*4·47	*2·85	*3·31	5·36	*2·53	1·76	0·82	5·04	11·82
Silica	4·04	6·15	7·02	4·89	2·06	3·17	2·99	3·17	2·07	*0·05
Phosphate of lime	2·19	5·53	9·88	13·64	16·80	19·36	20·25	22·10	21·61	24·92
Carbonate of lime	8·25	1·78	*0·70	*5·64	*10·92	*11·86	*14·81	*16·46	*16·38	*14·86
Carbonate of magnesia	3·04	1·01	1·22	1·67	2·30	1·65	1·22	0·67	0·45	0·01
Specific gravity	25·40	63·60	65·90	74·40	82·20	91·50	99·50	127·40	129·40	131·30

* Decrease.

TABLE C.

INCREASE PER 1000 PARTS OF URINE.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10	Average.
Dry solid matter	33·25	39·77	42·15	41·61	43·53	41·60	42·23	43·46	43·51	45·51	41·66
Char	6·20	11·54	14·90	14·91	16·12	16·41	16·69	17·08	17·13	18·34	14·93
Sulphate of ammonia ..	30·07	34·51	29·90	29·32	29·57	29·71	30·00	30·78	30·73	31·62	30·62

RESIDUAL CHARS.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Average.
Water	—	—	—	—	—	—	—	—	—	—	—
Soluble salts	8·14	10·52	12·76	14·24	14·93	16·13	15·71	16·09	15·96	16·69	14·12
Insoluble	5·36	6·07	4·76	3·01	3·07	1·86	2·28	2·15	2·26	2·60	3·34
Soluble.											
Chlorine = ...	5·16	5·26	6·37	6·68	6·95	7·69	8·14	8·42	8·28	8·89	7·18
Chloride of sodium	8·59	8·76	10·64	10·13	11·59	12·81	13·58	14·04	13·83	14·66	11·86
Sulphuric acid	0·24	0·47	0·55	1·31	1·27	1·30	0·56	0·56	0·59	0·16	0·70
Phosphoric acid..	—	—	—	—	—	—	—	trace	trace	trace	—
Potash..	2·13	2·43	2·10	2·98	2·84	3·50	3·34	3·25	3·27	3·48	2·93
Insoluble.											
Carbon	*12·00	*2·23	*0·71	*0·83	1·07	*0·42	0·25	0·10	0·56	1·18	*1·30
Silica	4·04	3·07	2·34	1·22	0·41	0·53	0·42	0·39	0·23	—	1·40
Phosphate of lime	2·19	2·76	3·27	3·41	3·36	3·22	2·89	2·76	2·40	2·49	2·87
Carbonate of lime	8·25	0·89	*0·23	*1·41	*2·18	*1·98	*2·11	*2·06	*1·82	*1·48	*0·41
Carbonate of magnesia ..	3·04	0·50	0·40	0·42	0·46	0·27	0·17	0·08	0·05	—	0·59
Specific gravity	25·40	31·80	21·96	18·60	16·44	15·25	14·21	15·92	14·37	13·13	18·71

* Decrease.

TABLE D.

RESULTS OF TREATING CLOSET EXCRETA.

No. of Expt.	No. of Deposits.	Weight, Wet.	Weight, Dry.	Char Used.	Char Produced.	Char, Increase.	Liquid Distilled.	Tar	Acetate of Lime.	Free Ammonia as Sulphate.	Combined Ammonia as Sulphate.	Total Ammonia as Sulphate.	
		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Grs.	Grs.	Grs.	Grs.	
1.	7	Estimated weight, 490 ozs.	Estimated weight, 110 ozs.	48·00	48·00	—	65·50	Estimated weight, 10 ozs.	Estimated weight, 1977 grs.	1229·00	Estimated weight, 1712 grs.		Partial Analyses.
2.	6			48·00	48·00	—	21·50			643.00			
3.	5			44·00	48·00	4·00	20·50			613·00			
	18												
4.	19			76·00	81·50	5·50	37·50			1310·00		11310	
	37												
5.	24			80·50	93·00	12·50	38·50			1721·00			
	61												
6.	24			93·00	104·00	11·00	34·50			1852·00			
	85												
7.	24			98·00	107·50	9·50	39·50			2230·00			
	109												
8.	24	113·00	36·00	104·50	111·50	7·00	53·50	2·50	479·60	1756·00	268·00	2024·000	Complete Analyses.
	133												
9.	24	93·00	18·00	105·50	108·50	3·00	34·50	2·50	503·60	1502·00	343·00	1845·000	
	157												
10.	24	112·00	18·00	98·00	102·50	4·50	33·50	1·50	300·80	1278·00	215·00	1493·000	
Total	181	808·00	182·00	795·50	852·50	57·00	379·00	16·50	Ozs. 7·46	Ozs. 32·32	Ozs. 5·81	Ozs. 38·130	
Average per deposit		4·46	1·00	4·39	4·71	0·32	2·09	Grs. 39·76	Grs. 18·01	Grs. 78·08	Grs. 14·02	Grs. 92·100	
Per cent, wet..		100·00	22·44	98·43	105·62	7·19	46·86	2·04	0·92	6·24	0·71	6·950	
Per cent, dry..		—	100·00	439·00	471·00	32·00	209·00	9·10	4·12	27·84	3·19	31·030	

Char dried and used seventeen times; re-burnt ten times. The distillations also produced about 1 oz of light hydrocarbon.

TABLE E.

ANALYSES OF CHARS FROM CLOSET.

	Ordinary Char.	Composition. 1.	2.	3.	4.	5.	6.	Increase, per cent. 1.	2.	3.	4.	5.	6.
No. of Deposits	37	85	109	133	157	181	37	85	109	133	157	181
No. in Table D.	4.	6.	7.	8.	9.	10.	4.	6.	7.	8.	9.	10.
Water	10·00	1·20	1·20	2·00	1·80	—	—	—	—	—	—	—	—
Soluble	0·60	4·70	9·20	8·30	10·10	9·20	9·60	4·10	8·60	7·70	9·50	8·60	9·00
Insoluble	89·40	94·10	89·60	89·70	88·10	90·80	90·40	4·70	0·20	0·30	*1·30	1·40	1·00
Soluble.													
Chlorine =	—	2·16	3·45	3·69	4·16	4·50	4·75	2·16	3·45	3·69	4·16	4·50	4·75
Chloride of sodium	—	3·60	5·75	6·15	6·93	7·50	7·91	3·60	5·75	6·15	6·93	7·50	7·91
Sulphuric acid	0·30	0·85	1·00	trace	1·02	0·68	1·40	0·55	0·70	—	0·72	0·38	1·10
Phosphoric acid	—	trace	trace	trace	trace	trace	trace	trace	trace	trace	trace	trace	trace
Potash	0·30	0·30	4·10	3·46	3·46	4·61	5·57	—	3·80	3·16	3·16	4·31	5·27
Insoluble.													
Carbon	54·40	41·80	42·20	44·80	41·50	44·00	43·40	*12·60	*12·20	*9·60	*12·90	*10·40	*11·00
Silica	9·10	15·20	12·40	12·50	12·80	12·00	11·80	6·10	3·30	3·40	3·70	2·90	2·70
Phosphate of lime	4·80	13·50	15·60	20·00	21·06	21·20	21·40	8·70	10·80	15·20	16·26	16·40	16·60
Carbonate of lime	17·40	20·40	12·40	8·60	7·00	11·60	11·20	3·00	*5·00	*8·80	*10·40	*5·80	*5·40
Carbonate of magnesia	3·10	3·50	5·60	1·20	2·10	2·00	2·00	0·40	2·50	*1·90	*1·00	*1·10	*1·10
Specific gravity (relative	1000	1319	1638	1720	1769	1700	1667	31·90	63·80	72·00	76·90	70·00	66·70

WASHED CHARS.

	Ordinary Char.	Composition. 1.	2.	3.	4.	5.	6.	Increase, per cent. 1.	2.	3.	4.	5.	6.
No. of Deposits	37	85	109	133	157	181	37	85	109	133	157	181
No. in Table D.	4.	6.	7.	8.	9.	10.	4.	6.	7.	8.	9.	10.
Carbon	54·40	44·46	47·98	51·43	49·13	49·43	48·22	*9·94	*6·42	*2·97	*5·27	*4·97	*6·13
Phosphate of lime	4·80	14·37	17·41	22·96	24·93	23·34	23·77	9·57	12·61	18·16	20·13	18·54	18·97
Carbonate of lime	17·40	21·70	13·83	9·87	8·28	12·77	12·44	4·30	*3·57	*7·53	*9·12	*4·63	*4·96
Carbonate of magnesia	3·10	3·30	6·25	1·37	2·48	2·09	2·22	0·20	3·15	*1·73	*0·62	*1·01	*0·88

* Decrease.

matter is characteristic of excreta, and is shown in the large quantity of tar yielded in the distillation—over 9 per cent; wood yielding only 10 per cent, and coal 12 per cent. The yield of ammonia equals 31 per cent of sulphate, showing this to be a most prolific source. It is remarkable that the re-burning shows the products of distillation of vegetable matter—acetic acid, for instance, combined with those from animal matter, as ammonia, for example, arising from the mixed nature of the human food. These experiments were conducted on excreta from poorly-fed lads: amongst good livers, the nitrogen, phosphates, and fatty matter would probably be much increased. These tables represent, therefore, the minimum yield. Taking these data, 1 ton of char which had been used five times would yield, allowing 15 per cent moisture, 48 cwts. of manure, containing nitrogen equal to 18 per cent sulphate of ammonia, 15 per cent phosphate of lime (reckoned as soluble), and 7½ per cent sulphate of potash, and worth £7 per ton. Its cost for char, £2, and for cartage, 5 tons in and 10 tons out, equal 15 tons at 1s., equal 15s. If advisable to hasten its sale by drying, it would cost 10s. more, the total cost being £3 5s., or about 28s. per ton. If re-burnt and returned to the closet, the re-burning would cost 3s. 6d. per ton, or 8s. 6d., and yield over 8 cwts. sulphate of ammonia at 16s., equal £6 8s. less cost of acid, and, allowing 10 per cent for moisture, 33 cwts. of char, partly to return to the closet and partly for sale as manure, and worth about £5 per ton. I think these data are sufficient to show that this process presents the means of recovering the total value of the excreta. In addition, there are other unexpected sources of further profit; for 100 tons of dry, solid excreta yield 9 tons of tar and 4 tons of acetate of lime, besides a considerable quantity of richly-illuminating gas.

I have brought this subject before the Section in the full belief that it must some day become a chemical question; and I maintain that engineers have shown their incompetence to deal with it alone. Water-closet excreta is now admitted to be the worst poison to put into our rivers; and why should such volumes of water be thus employed for such pollution? If this large amount of water be unnecessary, if, moreover, it be grossly wasteful and fearfully prejudicial to health, it becomes our duty to discuss any other method by which chemistry may be made available to secure that which has hitherto been lost. I repeat here my conviction expressed in a former paper—that "Every system of sewage, to be permanent, must give back to the soil that which in our food we have taken from it; and the mere ridding ourselves of a valuable fertiliser simply on account of difficulty in dealing with it is unworthy the enlightened spirit of our age." At the same time, I admit that considerations of health must always precede those of wealth in this respect, and no system need be spoken of against which there is a whisper of suspicion on this point.

Nothing can be said against the dry-closet in this respect. It has already become a recognised institution. It presents the best means at present known of confining a nuisance within its proper limits, instead of distributing it amongst our neighbours, and therefore merits our patient consideration.

There can be no doubt that, for country houses, the earth-closet is free from objection; but there is also no doubt that, with earth, it could not be applied to large towns; but, with the modification proposed, its use will be profitable in direct proportion to the size of the town. By its use we are enabled to store the manure for the farmer, and dispose of it when he wants it, and not whenever we want to get rid of it, which materially affects the market price.

While, therefore, there can be no doubt of the healthfulness of this process, I believe enough has been proved in this paper to show that the gradual introduction of char-closets will become national stepping-stones to health and wealth.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, October 11, 1869.

The first paper is by M. Duhamel, on the—

Principles of the Science of Forces.—This is the third portion of a work the author is occupied with, the two former parts treating of the science of numbers and the science of space. We mention the title because the writer is an excellent authority on this and kindred subjects.

Expansion of Gases.—M. Victor Regnault.—The author refers, first, to his series of experiments on this subject made since the year 1842, and states that he believed he had found a method to determine with the same apparatus, first, the specific heat of a gas under constant pressure and variable volume; and, secondly, its specific heat under constant volume, while the pressure varies so as to leave the volume (bulk) constantly the same. Next follows the description of a series of experiments, and conclusions drawn therefrom, made at a later date; while the lengthy memoir is devoted to what the author calls simple expansion, or static expansion—that is to say, the expansion of a gas while at rest, when, by any exterior force, the space it occupies is made larger and the gas comes to rest again after the expansion. The other kind of expansion, called dynamic, is, when a gas, either while at rest or moving, expands while passing through any opening, and escapes into the calorimetric apparatus with all the velocity it has acquired. This memoir is of very great length, and the subject treated with the well-known ability of this eminent author, who, it will be remembered, satisfactorily settled the theory of the pressure of steam under various conditions.

Maximum of Force of Electro-Magnets.—M. du Moncel.—A mathematico-physical treatise.

Electricity Developed by the Dissolving of Salts in Water.—M. Raoult.—The author says the dissolution of a salt in water is a complex phenomenon whereby we distinguish—1st, the *fusion* (melting), or *disintegration* of the salt, whereby heat is absorbed; 2nd, the *diffusion* of saline molecules in water, which also absorbs heat; 3rd, the *combination* of the salt with water, whereby heat is set free. The author then states that the conditions alluded to under Nos. 1 and 2 do not produce any electricity, but that, on the other hand, the combination of a salt with water certainly does give rise to an electric current, to prove which the author records a series of experimental results.

Condensation (Occlusion) of Nascent Hydrogen.—M. Raoult.—The author states that the small cubes of metallic nickel ordinarily met with in commerce, and which are rather porous, absorb (condense) at least 165 times their bulk of nascent hydrogen under the same conditions as palladium does. The metallic nickel employed was not pure, but was found to consist, in 100 parts, of:—Nickel, 88·4; copper, 8·1; iron, 2·7; arsenic, 0·8. Perfectly pure, but yet porous, nickel exhibited the same phenomenon; but not so the compact refined, rolled, or hammered nickel.

Analysis of Raw Yellow Silks of Commerce.—M. Mène.—A series of figures exhibiting the results of the elementary and proximate analysis of a great many varieties of raw silks obtained from divers silk-producing countries of the world. The specific gravity appears to vary between 1·670 and 1·80. The elementary organic analysis is not of much use, since silk in raw state contains:—Substances soluble in water, partly nitrogenous, partly carbohydrates; fatty, resinous, and colouring substances soluble in alcohol and ether; and, lastly, the genuine fibre, a nitrogenous compound again soluble in acetic acid. It is impossible here to quote a lengthy series of figures, which is the less required since it is a well-known fact that raw silk varies considerably, according to to the food, climate, and condition of the worms which secrete this substance.

Researches on Lydine.—M. Guyot.—The author states that when he tried to prepare a certain aniline colour according to the directions given by M. Stark, by treating acid chlorhydrate of aniline with ferricyanide of potassium, and by treating the precipitate with oxalic acid, he did not succeed in obtaining a red colouring matter, as stated by M. Stark. The author obtained, however, a beautiful violet colour, which he calls *lydine*, by the following process:—100 grms. of fuming hydrochloric acid, diluted with 120 c.c.; this mixture is poured into a solution of 90 grms. of the ferricyanide of potassium (so-called red prussiate) and 850 c.c. of water; next boiled for an hour and a half, and cooled. The precipitate which has been formed is washed by decantation, and re-dissolved in a nearly saturated aqueous solution of oxalic acid, whereby the violet colour is immediately developed; and, on evaporating this solution to dryness, a paste soluble in water is obtained, which is the extract of lydine. The acid solution just alluded to may serve for dyeing silk and wool without mordants; cotton mordanted with alumina assumes the dye, also, readily. Pure lydine is a beautifully blue violet-coloured powder, soluble in alcohol, difficultly soluble in ether and benzol, and insoluble in water.

Elimination of Lime from Natural Waters by means of Oxalic Acid.—M. Monier.—Upon 100 litres of water from the Seine, 20 grms. of oxalic acid are used, previously dissolved in distilled water; an abundant precipitate is formed; after the lapse of twenty-four hours, some 85 litres of water are carefully drawn off by means of a syphon; and, on analysis, it was found that fully two-thirds of the mineral matter contained in the water had been precipitated, and the water rendered very soft. It is clear, however, that the use of oxalic acid could not be made applicable on the large scale, for various reasons, even if the acid itself was less expensive.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 14, 1869.

This number contains the following original papers:—

Preparation of Crystallised Silica by the Dry Way.—M. Rose.—After referring to the experiments made on this subject by himself and others, the author states that he resumed his researches on this subject at the Royal Porcelain Manufactory, at Berlin, and was aided in his work by MM. Elsner and Herzog. The mineral, named adular, was fused with three times its bulk of salt of phosphorus. The fused mass was dissolved in dilute HCl; and perfectly well-defined crystals, though of very small size, were obtained; the specific gravity of these crystals varied from 2·311 to 2·317 for a series of experiments made with the same substances. The silicic acid thus obtained has the properties of tridymite. Another series of similar experiments, made with very pure amorphous silica, yielded, again, microscopically-small crystals; but their shape did not differ from those obtained with adular. A large number of similar experiments were made with different fluxes, leading to the result that the preparation of crystallised silica by the dry way, or fusion process, has as yet only succeeded in the production of crystals shaped like tridymite and opal. The author is engaged in further investigations on this subject.

Bases of the Picoline Series.—M. A. Baeyer.—Picoline is obtained when tribromallyl is strongly heated with alcoholic solution of ammonia. There is, at first, formed dibromallylamine, and, next, picoline. Aldehydine, a newly-discovered base, prepared also by this author, is homologous with picoline. During the formation of aldehydine, there are formed oxytetraldine, oxypentaldine, and also collidine.

On Cinchonine-Chinoline.—M. Lubavin.—When chinoline is heated for some days, at 100°, with fuming sulphuric acid, the result is the formation of chinosulphuric acid, $NC_9H_6.SO_3OH$. This substance is difficultly soluble in cold water, more readily so in hot water and alcohol, and insoluble in ether. When this acid is heated, along with water and bromine, at 100°, there is formed a bromated chinoline, and, not simultaneously, a bromated sulpho acid. When chinoline is treated with a concentrated solution of caustic alkali, a greenish blue-coloured substance is produced, which is also produced when cinchonine is so treated; on addition of water, this colour disappears, and there is then formed a brown-coloured amorphous substance.

Products of the Distillation of Raw Spirits.—MM. Krämer and Pinner.—The authors had an opportunity of investigating the different products which, by the distillation of spirits—that is to say, the manufacture thereof—from grain, are formed, and can be separately collected, owing to the perfection of the rectifying apparatus in use, on the large scale. Among these substances are prominent—aldehyde, acetal, propyl-alcohol, butyl-alcohol, acetic ether, fusel oil, and a mixture of different substances.

On Monobromobenzolsulpho-Acid.—M. Genz.—The acid just named has been first prepared by M. Couper. The author has obtained it by placing benzol-sulpho acid, bromine, and water in sealed tubes, and heating to 150° in an oil-bath for about five hours. After a lengthy process of purifying, a substance was obtained of which the baryta, copper, and ammonia salts were investigated, and the acid itself set free from the copper salt, by means of sulphuretted hydrogen. The acid so prepared exhibits deliquescent crystals. The baryta salt, $Ba(C_6H_4BrSO_3)_2+H_2O$, is soluble in hot water and insoluble in alcohol. The copper salt, obtained from the baryta salt by double decomposition with sulphate of copper, crystallises readily, and is soluble in water and alcohol.

Nitro and Amido Derivatives from Cyanide of Naphthyl.—M. A. Welkov.—The author prepared, from a cyanaphthyl, $C_{11}H_7N$, a nitro-compound, which crystallises from its alcoholic solution, and is composed of $C_{11}H_6N_2O_2=C_{10}H_6(CN)(NO_2)$. From that compound, the amido base was obtained, by means of a reducing agent, the hydrochlorate of which has the formula $C_{11}H_9N_2Cl$.

Some Derivatives from Bromide of Aniline.—M. W. Otto.—Dibromated diphenylsulpho-carbamide, $C_{18}H_{10}Br_2N_2S$, a solid crystalline substance, soluble in alcohol, fusing at 178° and subliming at 200°; insoluble in water, both hot and cold, also insoluble in ether, and readily soluble in hot alcohol. Bibromated diphenyl-carbamide, $C_{18}H_{10}Br_2N_2O$, also a solid substance, sublimes at about 222°, with-

out entering into fusion. Quadribromated diphenyl-carbamide, $C_{13}H_8Br_4N_2O$, again a solid crystalline substance, difficultly soluble in any neutral menstruum. Bromated phenyl-senföl (essential oil of mustard), C_7H_4BrNS, a crystalline substance exhibiting the smell of aniseed, fusing at 60°, and soluble in alcohol and ether.

On Isomeric Xylidine.—Drs. A. W. Hofmann and C. A. Martius.—This paper, and the following—

On Naphthaline Red—Dr. Hofmann—are not well suited for abstraction with due regard to the contents and the labour of the authors.

Action of Cyanogen upon Anthranilic Acid.—M. Griess.—The author, after having briefly reviewed his former investigations on the action of cyanogen upon amido-benzoic acid, treats, in this paper, at very great length, on the action of cyanogen upon a compound, $C_{10}H_{10}N_2O_3$, being a product of the action of cyanogen upon an alcoholic solution of anthranilic acid left standing by itself for several days. We regret that it is impossible to enter into further abstraction of this paper, owing to the fact that we should be obliged to reproduce so large a number of formulæ.

Description of an Apparatus for Exhibiting Combustion Experiments in a Lecture-Room.—M. Kekulé.—Without the reproduction of the two woodcuts added to this paper, it is not possible to make the description properly understood.

On Ethyl-Benzoic Acid.—MM. Thorpe and Kekulé.—The authors and M. Fittig, having, some years since, synthetically prepared ethyl-benzoic acid from ethyl-benzol, the question treated of in this paper is, to decide whether the ethyl-benzoic acid obtained in this manner is identically the same as that obtained by the last-named party, by means of the oxidation of diethyl-benzol. The result of a carefully-instituted comparative research of the acids obtained in these different ways is that they are quite identical with each other.

On Acetylbenzol.—M. Glaser.—Acetylbenzol, phenylacetylen, $C_6H_5.C_2H$. This body has been prepared by the author from phenyl-propiolic acid and styrol, and which has been obtained by MM. Berthelot and Friedel by other means, is possessed of the remarkable property of combining with metals and metallic oxides, some of which are treated of in this paper. The copper compound of acetylenbenzol, $(C_6H_5.C_2)_2Cu_2$. Diacetenylphenyl, $C_{16}H_{10}$, is a solid substance, soluble in boiling alcohol and insoluble in water; it is a peculiar hydrocarbon, obtained when acetenylbenzol copper is treated with a concentrated alcoholic solution of ammonia. Acetenylbenzol sodium, $C_6H_5.C_2Na$; this substance has only an ephemeral existence; it is instantaneously decomposed, both by moist and dry air.

Communications from the Chemical Society at Zurich, called the Chemical Harmonica.—M. Meister writes—"At the meeting held on the 27th of July last, MM. Merz and Weith spoke about acetanilide. In pure state, this substance is soluble in hot water, fuses at 113°, crystallises very readily, and is decomposed by sulphuric acid, acetic acid being set free and sulphate of aniline formed. In order to detect acettoluide among acetanilide, the acetic compound is dissolved in four parts of glacial acetic acid, and next mixed with about eighty parts of water; hereby the acetanilide remains dissolved, while the acettoluide is precipitated. MM. Baltzer and Merz obtained, by distilling a mixture of potassium-disulphonaphthalate and cyanide of potassium, a peculiar cyanide of high melting point, soluble in hot alcohol; this dicyannaphthaline is entirely acidified (*acidificirt*) by treating it with alcoholic solution of potassa, or by HCl at about 199°, while ammonia is at the same time generated.

Derivatives from Uramidobenzoic Acid.—M. Griess.—Uramidobenzoic acid, $C_8H_8N_2O_3$, is prepared by the action of a mineral acid upon a peculiar basic compound, $C_{30}H_{30}N_4O_9$, obtained by the action of cyanogen and an alcoholic solution of amidobenzoic acid. In this lengthy monograph, the author treats of several derivatives obtained from the uramidobenzoic acid by the action of nitric acid; among these new compounds, dinitro-uramidobenzoic acid, $C_8H_6N_4O_7$, is soluble in alcohol and ether, yielding, on evaporation, well-defined crystals. The paper is too concisely and abstrusely written to be fit for further condensation.

Illustration of the Phenomena of Combustion for Lecture Experiments.—Dr. A. W. Hofmann.—We greatly regret that, in consequence of the absolute necessity of the woodcut added to this paper, for it to be properly understood, we cannot abstract this communication of the eminent author.

Nature of Aniline Green.—MM. Hofmann and Girard.—We have already briefly noticed this memoir (see CHEMICAL NEWS, vol. xx., p. 153). This German paper is identical with the French one already alluded to.

On those Compounds of Essential Oil of Mustard which are Isomeric with Hydrosulphocyanic Acid.—Dr. A. W. Hofmann.—This is a fifth paper on this subject, not well suited for condensation with due regard to the labour bestowed upon the contents by the learned author.

Researches on the Products of Desulphuration of Diphenyl-sulphocarbamide.—Dr. A. W. Hofmann.—This memoir is too lengthy and too concisely written for any useful abstraction.

On some Superiodides.—M. Jörgensen.—This paper is an abstract of a larger memoir on this subject. The author treats of the superiodides generated when neutral or acid solutions of the hydrochlorates of morphia, codeia, papaverine, narceine, and narcotine are treated with solutions of iodine in iodide of potassium, in which case superiodides are formed which exhibit crystalline structure. Tetraiodide of morphia, $C_{17}H_{19}NO_3HI_4$, is precipitated in crystalline form when, to the aqueous solution of the salt of morphia, an excess of iodide of potassium is added. Teriodide of codeine and teriodide of papaverine, the former, $C_{18}H_{21}NO_3HI_2$, the latter, $C_{20}H_{21}NO_4HI_2$, have been found to contain hydriodic acid, since the alcoholic solutions, when shaken up with metallic mercury, yield double salts, only containing two equivalents of mercury. Sesquiiodide of narceine, $(C_{23}H_{29}NO_9)_2H_2I_3$, is formed when a very dilute solution of the hydrochlorate of the alkaloid is left standing for several weeks, after having been mixed with a dilute solution of superiodide of potassium. The author has extended his researches to piperine, atropine, berberine, theobromine, chinine, cinchonine, methylchinine, methylchinidine, ethylchinine, and ethyl-cinchonine; also to tetrethylphosphonium; but the great length and the large number of formulæ contained in this paper forbids us entering into more details on this subject.

This number of the periodical contains the queries to which answers are requested:—1st. By the Royal Prussian Academy of Sciences at Berlin; to be replied to before the 1st of March, 1870. The question proposed is the synthesis of either one or more such alkaloids as chinine, cinchonine, morphine, strychnine, brucine, or any non-nitrogenous compound so related to these bodies, that, by the action of ammonia, it can be converted into the aforesaid bases; prize, 100 ducats, about £50. For 1872, the same premium for a full investigation of the nitrogenous substances contained in wheaten flour and rye flour, and the changes these substances undergo when acted upon by water. 2nd. The Association for the Promotion of the Industry of Prussia asks—The preparation of an enamel on cast-iron, of variegated colours, to be unaffected by exposure to air, and to have proved effectual for at least one year; premium, 300 thalers (£45). For a suitable substitute for the use of arsenic acid in the manufacture of fuchsine (aniline red), provided the substitute be no more expensive and not poisonous or dangerous to deal with; a gold medal, or 1000 thalers (£150). For good replies to the subjoined questions, the same premium:—(1) A method whereby the quantity of aniline and toluidine contained in commercial aniline (*anilinöl*, literally aniline oil) can be accurately, readily, and speedily determined; (2) to determine the influence which the various mixtures of these two substances have in regard to the quantity of aniline obtained; (3) to estimate what weight will yield the largest quantity of crystallised pigment. These three particulars have each to be answered in order to satisfy for the premium. The last meeting of the Chemical Society of Berlin, was held on the 11th of October, this being the report of the meeting held on July 26th last.

Bulletin de la Société Chimique de Paris, September and October, 1869.

These two numbers have been published together, and contain the following original matter:—The *procès verbaux* of the meeting of this Society, held on the 2nd and 16th of July last, from which we learn that M. Personne described two new combinations of sulphuric and pyrogallic acids obtained by him. One of these, a conjugated disulphuric acid, exhibits needle-shaped crystals; its baryta salt is efflorescent. This compound is accompanied by a blue substance, a product of oxidation. In addition to these, there is formed a monosulphuric acid, a solid substance, crystallising in large crystals, which, on the addition of baryta, yields a beautiful purplish colour. The author has estimated the sulphuric acid in these compounds by burning them in a current of oxygen gas, and conducting the products of combustion into a solution of permanganate of potassa, and precipitating the sulphuric acid by means of baryta. M. Grimaux spoke on a new kind of nitriles, the oxygenated nitriles of the aromatic series. Salicylo-nitrile, C_7H_5NO, is obtained by the dehydratation of salicylamide by keeping it at a temperature of from 280° to 300°. The new product is a solid body, crystallising in yellow-coloured crystals, fusing at about 285°; almost insoluble in ether, alcohol, chloroform, sulphide of carbon; soluble in 200 parts of boiling oil of turpentine, soluble in aqueous and alcoholic solutions of caustic potassa, and, by fusion with that substance, is transformed into salicylic acid.

The following papers and memoirs were read:—

On a Homologue and Isomer of Choline.—M. Wurtz.—This paper is chiefly intended to point out the identity of neurine and choline, which last-named substance was originally found by M. Strecker in bile, while neurine, as discovered by the author of this paper, is artificially produced by the action of triethylamine upon hydrochlorate of glycol.

Action of Hydrochlorate of Glycol upon Toluidine.—M. Wurtz.—The author describes the action of hydrochlorate of glycol upon aniline and toluidine, exposing at great length the different reactions which take place, and the preparation of divers salts, especially with platinum as basis. The memoir is too lengthy to admit of useful abstraction.

Synthesis of Naphthalin-Carboxylic Acid.—M. Eghis.—This acid is obtained by acting with sodium amalgam upon a mixture of monobromated naphthalin and chloroxycarbonic ether. The acid so obtained appears to be identical with the menaphtoxylic acid of M. Hofmann, but differs from the carboxylic acid obtained by means of the cyanide of naphthyl prepared from sulpho-naphthylate of potassium by M. Merz.

Action of Anhydrous Sulphuric Acid upon Perchloride of Carbon.—M. Schutzenberger.—There is produced a liquid boiling at 130°, decomposed by water into sulphuric and hydrochloric acids, fuming in the air, and giving off a smell which is similar to that given off by some of the chlorides of the metalloids. The action of anhydrous sulphuric acid upon tetrachloride of carbon is represented by the following formula:—$S_2O_6 + CCl_4 = CCl_2O + S_2O_5Cl_2$.

Synthesis of Glucosides.—M. Schutzenberger.—The chief result obtained by the author is that the synthesis of genuine glucosides which agree in their properties with those formed naturally,

is possible by means of the double decomposition of the acetic glucoses (*glucoses acétiques*) and the lead or soda salts of several organic principles. The author is engaged in further researches on this subject.

Acetic Derivatives of the Sugars.—MM. Schutzenberger and Naudin.—This paper is too lengthy and too concisely written to admit of useful abstraction.

Inuline and its Acetic Derivatives.—MM. Ferrouillat and Savigny.—The authors have prepared inuline from dahlia root and from the root of the inula helenium. Notwithstanding that these substances have been carefully manipulated, so as to ensure the purity of the inuline, it appears that, from the experiments made, that this substance, as obtained from either of the two roots named, does not behave in the same manner when treated with acetic acid under exactly similar conditions, but yields products of decomposition which vary greatly. It is impossible to enter into details about these researches, since the paper is too lengthy for that purpose.

Oxidation of Pseudoctylic Alcohol.—M. Clermont.—The products obtained are the same as those yielded by castor-oil when it is oxidised.

Action of Permanganate of Potassa upon Cinchonine and the Existence of a New Alkaloid of the Cinchona Species.—MM. Caventon and Willm.—We have given an abstract of this from another publication.

Salts of Phenetosulphuric Acid.—MM. Opl and Lippman.—Phenetol is—

$$\left.\begin{matrix} C_6H_5 \\ C_2H_5 \end{matrix}\right\} O$$

It boils at about 169°. The authors describe a baryta salt of this substance, $(C_6H_4SO_6C_2H_5O)_2Ba'' + 4H_2O$, a phenetolsulphate of baryta, nearly insoluble in cold, but soluble in hot, water. Phenetosulphate of lead, crystallising in cauliflower-like masses, soluble in water. Phenetosulphate of potassium—

$$\left.\begin{matrix} C_6H_4SO_6K \\ C_2H_5 \end{matrix}\right\} O + H_2O$$

is obtained by decomposing the baryta salt by means of carbonate of potassa. The salt obtained is readily soluble in water, and crystallises in needle-shaped crystals.

Structure of Cubical Pyramidal Crystals.—M. Wyrouboff.—This paper is not suited for abstraction, being a strictly crystallographico-geometrical paper.

Cresotic and Salycilic Acids.—M. Vogt.—By means of a complicated process, commenced by acting upon chlorinated xylen with fuming sulphuric acid, an acid has been obtained which is soluble in hot water, insoluble in cold water; soluble, also, in alcohol and ether, and violet-coloured by salts of iron. This acid is composed, in 100 parts, of:—C, 63·1; H, 5·12; O, 31·78. When toluen was treated in the same manner, salicylic acid, $C_7H_6O_3$, was obtained.

Succinate and Benzoate of Isopropyl.—M. Da Silva.—We have already abstracted the contents of this memoir, which was also published in another periodical.

There is added to this number a loose sheet, bearing title—

Ecole Supérieure des Sciences Appliquées de Mulhouse (*Laboratoire de Chimie*).—From this programme, approved and signed by the Recteur de l'Académie de Strasbourg and other authorities, we learn that there exists at Mulhouse an excellently-arranged school for the education of those who are either to be the heads or future managers of industrial works of various kinds. There is attached to this school a large and well-fitted chemical laboratory, wherein every opportunity is given for practical working, and at a very moderate expense, considering that thirty hours a-week are devoted to chemistry alone. The regular course of this school extends over two years, after which period those who desire it are examined, and certificates are granted, which are considered as rigorous proof of real efficiency. This school is, in miniature, what the celebrated Ecole Centrale des Arts et des Manufactures at Paris is on a large scale. Both these schools were originally established by private enterprise, and have become highly and deservedly esteemed, and are therefore fully approved of by the authorities of the Université de France.

Polytechnisches Journal von Dingler, first number for September, 1869.

This number contains the following original papers relating to chemical science:—

Proper Mode of Applying Zinc-White as a Pigment.—Dr. Dingler.—The author disapproves of the use of any substances containing lead, or any preparations thereof, along with zinc-white. He recommends, instead of the use of ordinary boiled linseed oil, to mix the zinc-white with an oil prepared in the following manner:—200 lbs. of linseed oil are gently boiled, first, for some five or six hours alone, and, next, boiled again along with 24 lbs. of coarsely-broken-up peroxide of manganese for at least twelve hours; in this manner, a very quickly-drying linseed oil is obtained, which is eminently fit for the purpose of being used with zinc-white and other zinc colours. The author lays stress upon the use of old linseed oil, and also upon the care to be taken with the boiled oil, which unless carefully kept from access of air, becomes thick in a very short time. The boiled oil so prepared ought not to be used in painting with zinc-white by itself alone, but should be mixed, in quantities of from 3 to 5 per cent, with the raw linseed oil used to mix up the paint.

Optical Milk Test.—Dr. Heeren.—This is a lengthy essay on a subject of great importance. The author points out that chemical analysis only is the proper mode of testing the quantity of butter contained in milk; but he also observes that this requires more knowledge, and also more time than those practically interested in this subject can devote to it. The author then reviews a variety of instruments devised for the purpose of testing milk; among these, M. Chevalier's crämometer is noticed. In the first place, the awkwardness of this instrument is due to the fact that the milk has to stand therein for at least twenty-four hours; and, although for milk intended for butter-making this is no objection, it is not desirable for daily use. The optical milk-testing apparatus devised by M. Donné, in the year 1843, and M. Vogel, in 1862, are described, and their value reviewed. The general results obtained by this author may be recapitulated as follows:—Skimmed milk contains fat globules of smaller size than unskimmed milk; smaller globules produce a relatively greater turbidity than larger-sized globules. Since the value of the optical milk-test is based upon the degree of non-transparency, it cannot yield correct results for wholly or partly skimmed milk. Carefully-made experiments prove that the use of M. Vogel's galactoscope gives perfectly correct results, but only for pure and unskimmed milk. By means of a combined optico-chemical investigation, it is possible to detect the precise quantity of fatty matter withdrawn from milk. The increase of the specific gravity of milk by skimming it is in direct proportion to the quantity of fatty matter withdrawn.

Quantitative Analysis of Soap.—M. Span.—Too lengthy to admit of useful abstraction.

Crystalline Coloured Substance Prepared from Mica.—Dr. Tech.—This paper contains the results of researches made with the view to detect the colours applied to minute pieces of mica used for ornamental purposes under the name of *brocate*. The following colours were tested:—*Rose red.*—Proved to be cochineal. *Carmine red.*—The colour is soluble in hot water; ammonia destroys the colour, HCl makes it yellow; colour is soluble in spirits of wine; the colour of that solution is destroyed by ammonia; colouring matter is, therefore, fuchsine. *Violet.*—Hardly soluble in water; completely soluble in water acidified with acetic acid; discoloured by ammonia; turns first green, and then yellow, by addition of hydrochloric acid. *Bright blue.*—Insoluble in water and water acidified with acetic acid; insoluble in alcohol; soluble in aqueous solution of oxalic acid; discoloured by alkalies. *Berlin blue.*—Deep blue; as far as tests could prove, this appeared to be Girard's violet, green, a mixture of aniline blue, and turmeric. Violet blue was evidently obtained with log-wood, and this was also applied to black.

Non-Porous Copper Castings may, according to the editor, be obtained by melting copper in plumbago crucibles previously lined inside with pipe-clay and dried. As soon as copper, while in molten state, is in contact with coal or carbonaceous matter, it yields a porous and spongy casting.

Pharmaceutische Zeitschrift für Russland, August, 1869.

This number contains the following original papers:—

Contributions to a Monograph on Inuline.—M. Dragendorff.—This paper is the first instalment of a memoir on inuline; it contains—(1) an historical introduction; (2) an essay on the different species of plants and parts of plants in which inuline is found; to these belong *Inula Helenium, L., Taraxacum officinale, Cichorium Intybus, Anacyclus officinarum, Helianthus tuberosus.* Inuline (also known as *helenin, alantin, dahlin, menyanthin*) is chiefly contained in the roots of the plants alluded to; it is a substance isomeric with, and in its properties similar to, starch, and was discovered in 1804 by M. V. Rose; its formula is $C_6H_{10}O_5$. The paper on this subject is to be continued.

Comparative Essay on the Characteristic Properties of the Halogens and their Combinations, and particularly on Hyperiodic Acid.—M. Ferrein.—This is the last instalment of a very lengthy essay on this subject.

Method for Rapidly Separating the Nitrates of Silver and Copper from each other.—Dr. Palment.—The author had to prepare nitrate of silver from small silver coins which contained a large percentage of copper. The alloy is dissolved in nitric acid; the solution is filtered if necessary, and evaporated until it has the consistency of a thickish oil; when this point is reached there is added to the solution very concentrated nitric acid free from HCl. By this proceeding all the nitrate of silver is precipitated, while nitrate of copper remains in solution. One part of the concentrated metallic solution requires from three to four parts of nitric acid for the complete precipitation of the nitrate of silver; the more concentrated the nitric acid is so much the better, but acid of 1·250 sp. gr. answers the purpose. The solution of copper is decanted off, and the nitrate of silver washed with nitric acid.

Researches on the Excrements of the Silkworms.—Dr. Palment.—These excrements contain 13·33 per cent ash, composed of potassa, soda, a trace of magnesia, carbonic, sulphuric, phosphoric acids, and chlorine. Among the organic substances contained in these excrements, the author found starch, mucus, sugar, tannin, and a peculiar green pigment. The worms had been fed only on the leaves of the white mulberry tree.

On Jantak-Schakar.—Dr. Palment.—Under this name there is sold in the towns of Central Asia a yellowish-coloured, dirty, hygroscopic substance, which is used as sugar, but the author has not been able to learn how it is obtained and from what plant it is derived; he found it did not contain mannite, and yielded on analysis, in 200 parts:—Sugar, 56; water, 11·4; impurities, 21·7; the latter being partly woody fibre, and partly inorganic salts.

Researches on a Petroleum from the Kirgisensteppe.—M. Both.—This oil occurs in wells at a considerable distance from

Orenburg; its colour is brownish-black, its consistency like tar; specific gravity, at 14°, 0·87; it contains 17 per cent of water, wherein 0·80 per cent of sulphate of protoxide of iron, readily soluble in ether, alcohol, benzol, chloroform, oil of turpentine, and miscible in every proportion with fatty oils; boiling point, 380°. This oil is purified with great difficulty; it contains 1·87 per cent of sulphur.

Les Mondes, October 7, 1869.

This number contains the following original communications:—

On the Radiant Heat from the Moon.—M. Marié-Davy.—The author says:—I do *not* admit that there is any essential difference between light and heat; I do not say that the *vis viva* of the moon's rays is *nil*, but I say it is so infinitesimally small that it is incapable of raising the temperature of an air-thermometer upon which the moon's rays concentrated by a strong lens were directed 0·0004°; and the heat radiated is not sufficient to raise the temperature 0·000001° when the bulb of the thermometer is directly exposed to the moon's rays. Suppose we apply either a lens ten times stronger than the one we employed, or a thermometer ten times more sensitive, and we thereby magnify the effects of course so that a motion of 1 m.m. will take place which will be very perceptible. If my observations were contradicted by those made by the late Lord Rosse, that nobleman ought to have drawn from his observations the conclusion that the direct rays of the moon were capable of elevating the temperature of a thin blackened object 0·000001°. The sun's rays increase about 12° the temperature of a thermometer placed in an apparatus invented by the Rev. Father Secchi, S. J., the obvious result of my observation alluded to above would lead to the result that the *vis viva* of the sun's rays is 12,000.000 times larger than those of the moon's rays. The moon by no means reflects the total quantity of rays which she receives, and since, in all probability, its radiation is diffuse, it follows that its rays when arriving upon our planet are weakened in the ratio of the square of the diameter of the moon's orbit and of the diameter of the moon itself. The moon's rays are not necessarily of the same composition as those of the sun, and it is a well-known fact that the calorific power is not proportionate to the illuminating power in the sun's spectrum. A common argand lamp placed at a distance of two metres from my experimental thermometer by the heat radiated from it caused the mercury to move through more than 1 m.m. of space, while the moon's image, though giving far more light, did not cause the mercury to move at all.

Naphtha as Fuel for Locomotive Engines.—M. Portski.—This Russian engineer has run a railway train successfully for a distance of 81 versts* from Charff to Kutschigan, the only fuel applied being raw commercial naphtha, instead of coal, coke, or wood.

The Journal of the Franklin Institute, August, 1869.

This number contains the following original papers and communications:—

Old and New Coal.—Dr. Morton.—The author says:—Attention has been lately drawn to a curious observation, which is given as a fact without sufficient explanation. In one case, where hard coal is used in large quantities for purposes of mere evaporation, it appears that some which has been kept on hand in open piles for five or six months is less effective by from 13 to 15 per cent than that fresh from the pit. The deterioration caused by the absorption of water is, of course, well known, but does not seem to apply to these cases. The fact here alluded to is very well known in this country (England), and also elsewhere on the European continent, but is not quite scientifically explained.

The New Chemical Nomenclature.—Dr. Ott.—This is the first portion of a lengthy paper which the author intends to publish on this subject. He says—"The deficiency of the present system of chemical nomenclature, though immensely felt for many years, has been chiefly brought to light by the astonishing strides of organic chemistry." The author points out the great inconvenience of a nomenclature containing names with seventeen or more syllables; though, in a less distinct manner, this deficiency is also felt in the domain of inorganic chemistry. We meet here such scarcely pronounceable denominations, as "hypersulpho-molybdate of potassa," "sesquibasico-ammoniaco-sulpharseniate of soda," and many others. The author proceeds to point out that the history of the spoken language of chemistry shows more clearly than that of any other science its various conditions in the succeeding stages of progress. The early cultivators of science hid their doctrines under the veil of an obscure figurative language, adopting at the same time particular characters for signifying bodies known to them. In the belief that the celestial bodies exercised a direct influence on terrestrial products, they consecrated the metallic and other substances to the seven so-called planets. As instances, we mention that to Saturn were consecrated the lead, litharge, and agate; to Jupiter, tin, corals, all white stones, and sulphur; to Mars, the iron, loadstone, and pyrites, and so on. Traces of this nomenclature yet remain in such terms as *Arbor Dianæ*, tincture of Mars, Martial pyrites, and lunar caustic. The term *sal* has been used since the oldest times for everything tasting like salt, or even for such substances as carbonate of potassa, which share only some properties with the same—viz., solubility in water, deliquescence, and colour. As instances of figurative expressions, we meet with *aqua ardens*, for alcohol, *lapis aquilinis*, &c. The author proceeds in this manner, passing in review the history of chemistry, but what has been quoted sufficiently exhibits the wide range he has taken for the full treatment of an interesting subject.

Camphoric Acid and some of its Combinations.—M. Fairthorne.—By repeated distillation of camphor with nitric acid, that substance is converted into camphoric acid by absorption of six equivalents of oxygen. The composition of camphor being $C_{20}H_{16}O_2$, that of camphoric acid is $C_{20}H_{14}O_6+2HO$. It (the acid) dissolves freely in alcohol and ether, moderately in water, but is insoluble in benzol and chloroform. It combines readily with ammonia and other alkalies; the ammonia salt crystallises in silky, star-like crystals. Its aqueous solution behaves, with the substances hereafter named, in the following manner:—With perchloride of iron, a light brown precipitate; no precipitate with the proto salts of iron; with sulphate of copper, a bright green precipitate; with solutions of salts of lead and mercury, dense white precipitates; no precipitation with sulphate of zinc, sulphate of morphia, sulphate of quinine, sulphate of cinchonia, sulphate of magnesia; none, also, with lime-water or soluble salts of silver. The author proposes to use the peculiarly bright green coloured precipitate yielded with sulphate of copper as a test for copper, since even 1 grain of sulphate of copper in a pint of water yields a distinctly perceptible colouration.

Cosmos, October 9, 1869.

Test for Berlin Blue.—The late M. Nicklès.—Shortly before his death, this *savant* pointed out that, when woven fabrics dyed with Berlin blue are steeped in a solution of fluoride of potassium, and then submitted to the action of steam, the colour of the tissue is at once discharged. Fabrics dyed with indigo or with aniline blue, when submitted to the same treatment, remain unchanged.

Drying of Wood.—For this purpose, the wood is kept for some hours under boiling water, whereby all its soluble parts are withdrawn. It is next left to dry, and then boiled for some time in a solution of borax, which causes the albumen to become soluble, and to escape from the pores. After this proceeding, the wood is placed in stoves heated by steam, and, in three days after the commencment of this series of operations, it has become quite dry and thoroughly seasoned.

NOTES AND QUERIES.

Magnesium Lamps.—(Reply to "C. Hunter.")—Messrs. Johnson and Matthey, of Hatton Garden, can give information about, and probably supply, every kind of magnesium lamp.

Magnesium Lamps.—(Reply to "C. Hunter.")—Larkin's magnesium powder lamp may be obtained of Mottershead and Co., Manchester.

Halliday's Machines.—Can any of your readers inform me where to find the makers of "Halliday's machines" for treating sawdust in the manufacture of pyroligneous acid and acetate of lime, and also the makers of the best wood-distilling apparatus.—A. W. N.

Carbonic Acid.—(Reply to CO_2).—Why not rather make carbonic acid by Ozouf's process, that is, by forcing air through previously strongly-ignited charcoal, contained in a properly constructed stove or furnace? It is true the gas thus obtained is contaminated with carbonic oxide and a very small quantity of combustible gases. The process alluded to by you is patented, I think, but it is certainly not a cheap process, and, if your limestone is tolerably pure, you had better dissolve it in either hydrochloric or sulphuric acids (both diluted with water, of course), and collect the gas thus set free.—J. A.

TO CORRESPONDENTS.

A Trustee.—It will be necessary for you to send your name and address before we insert your query respecting the Andersonian Institution.

E. N.—Apply to Messrs. Baillière, Regent Street, for the foreign journals you require.

F. Cox.—You will find information on the Uranium Process for Estimating Phosphoric Acid in Nos. 430 and 432.

PRACTICAL CHEMISTRY.

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* There are in use two kinds of measures called versts in Russia, which differ rather considerably in value, but one of these measures is only used in the Baltic Provinces of Russia; the verst more generally in use has a value of 1066·78 metres, the English statute mile being equal to 1609·315 metres; 81 versts is therefore equal to 53·6 English miles.

THE CHEMICAL NEWS.

VOL. XX. No. 518.

THE CHEMISTRY OF THE BLAST FURNACE, ACCORDING TO MR. I. L. BELL'S EXPERIMENTS.*

By M. CHARLES SCHINZ.

MR. I. LOWTHIAN BELL has lately read before the Chemical Society a paper on "The Chemistry of the Blast Furnace," this paper which is published in the Journal of the Society for June last, containing an account of a series of experiments which he has made on the process of the reduction of the iron ores in the blast furnace, and by means of which he intends to prove that this reduction takes place at a temperature much lower than that previously found by Scheerer, Ebelmen, and Tunner.

Mr. Bell comments at first upon the irregularity with which the layers in the blast furnace come down, and judges from that, that the volume of the blast furnace cannot be divided precisely into "zones." It should be stated, with regard to this, that it is absolutely wrong to charge a furnace with pieces varying much in size, this variation, of course, producing an unequal reduction and an irregular descent of the layers. But if this mistake is often made in England, it does not follow that the temperature in the blast furnace, with careful charging, should not decrease in an uniform and constant manner, so that it may really be divided into zones, limited by fixed temperatures: a difference of temperature is not even a necessary consequence of charging the furnace with pieces of unequal sizes, as the hot gases give up the heat with equal rapidity to large and small pieces, because this transfer depends simply upon the heat-conducting power of the materials. If, however, the free space between the pieces of the charge is not the same on both sides, the gases will rise much quicker on one side than on the other.

Of course small pieces of ore are more quickly and more completely reduced than larger ones, but large pieces, as well as small pieces, will be acted upon according to the existing temperature by the rising carbonic oxide; while, if they descend to such a depth of the furnace that the slag begins to run, the reduction ceases entirely, and afterwards it can only be accomplished, at a still higher temperature, out of the slag which contains oxide of iron by means of solid carbon. But that cannot influence the action of a zone of reduction, for the reduction by means of solid carbon is a different action, including other phenomena, and has to be examined separately.

If now the experimenters above named fixed the limits of their zones at very different heights of the shaft of the furnace, they have either erroneously taken the depth of the furnace as the extreme limit, whilst the volume of the zones ought to have been decided, or but very uncertain means of determining the temperature must have been at their command.

Mr. Bell has, on the other hand, put the ores to be reduced for a greater or less time into the iron pipes by which the gases are led from the furnace, and, moreover, into the pipes of furnaces of different size which, of course, give off gases of different temperatures; and, as he has thus found that a reduction takes place even at the melting point of bismuth (257° C.), he argues consequently that all that has been formerly stated about the temperature necessary for the reduction must be wrong. If Mr. Bell has really measured his temperature in a correct manner, of course then he is entitled to this conclusion; but it is a question whether Mr. Bell's measurement of the temperature does not depend upon a delusion. All compact metals possess a much greater heat-conducting power than the ores. If we put upon the bottom of a gas-pipe pieces of ores and a piece of metal, the latter will not melt, for the atmospheric air cools the tube from below, and deprives the piece of metal which is in contact with the tube of the heat necessary for the melting, whilst the pieces of ores, with less conducting power, are exposed to a perceptible higher temperature.

If we suppose that the temperature of the pieces of ore was the same as that of the piece of metal which served for ascertaining the temperature, the conclusion at which Mr. Bell arrived is still only delusively correct, for the conditions of the chosen method of operating are different to those existing in the blast furnace. The quantity of gas passing through in proportion to the mass of ores is much larger in the pipe leading off the gas than in the shaft of the furnace itself. My own experiments (see *Documente Betreffende den Hokofen*) have proved that the reduction is as much accelerated by the proportionate quantity of gas as by the amount of carbonic oxide which these gases contain, and that the intensity of the reduction, therefore, depends together upon temperature, quantity, and abundance of CO, and that no comparable results can be obtained without taking into consideration, and without determining, all these three factors. The influence of the composition of the gases upon the process of reduction has been presumed by Mr. Bell, and he has therefore, made special experiments with gases of the furnaces at Wrbna and at Clarence.

These gases have, according to Mr. Bell, the composition:—

13 CO + H, 16 CO_2, 71 N (Wrbna), and
32 CO + H, 6 CO_2, 62 N (Clarence).

But such a composition of blast furnace gases is almost impossible, for these gases must contain, if no direct reduction by means of solid carbon takes place, for 100 equivalent of nitrogen, 26·6 equivalent of vapourised carbon, and 26·6 equivalent of oxygen, plus the oxygen added by the reduction of the ores.

Now, the gases of the Wrbna furnace contain:—

13 CO and 16 CO_2
6·5 ,, 16 = 22·50 O
for 100 N = 31·69 O;

the surplus of oxygen from the ores would thus be only—

$$31{\cdot}69 - 26{\cdot}51 = 5{\cdot}18;$$

well, but whence came the 16 CO_2?

Besides 13 CO and 16 CO_2 contain
6·5 ,, 8 vols. = 14·5 C.,

which gives 20·42 carbon instead of 26·51 for 100 N.

The result of Tunner's analysis is, therefore, decidedly wrong.

The composition given for the gases of the Clarence furnace, namely:—

32 CO, 6 CO_2, 62 N,

is just as false.

These gases contain 22 volumes of O for 62 N, and this for 100 N = 35·48 O; next, also, they have 19 carbon for 62 N, or for 100 N there would be 30·64 carbon. The surplus of O thus equals 8·88 per cent, and of C = 4·04 per cent.

The gases of Clarence Iron Works should have, according to Mr. Bell's own calculation, the composition—

Cold Blast.

Weight of carbon	32·79	= volume	30·48
,, ,, oxygen	50·22	,,	35·11
,, ,, nitrogen	142·60	,,	113·48

per 100 N = 26·86 C.
30·94 O.

* *Engineering*, October 22, 1869.

The surplus balsam around the edges of the cover will require to be cleaned off; but this must not be attempted until it has become hard and firm. The hardening of the balsam may be much accelerated by the application of heat. The inside of a fender is a very convenient place for drying balsam-mounted slides. A drying apparatus for effecting this more quickly is described by Mr. D. E. Goddard, in the *Transactions of the Microscopical Society of London*, January, 1864, p. 45.

The simplest way of removing the surplus balsam is to make it very hard, and then wet the slide, and scrape away the balsam with a wet knife. It comes off very readily, and leaves the slide so clean that it can be easily finished with a rag and a little methylated spirit. Where the balsam is not very hard, it is better to scrape away as much as possible with a hot knife, and remove the remainder with alcohol, being very careful not to disturb the cover. The knife for scraping the slide should be softened by heating to redness and allowing it to cool, or it will scratch the glass.

The forceps and needles may be cleaned from balsam by heating in a spirit-lamp, and wiping with rag or blotting-paper. The forceps should be common brass ones, as steel would soon be spoiled, and the needles kept for this particular purpose, as they are useless for any other. Balsam may be removed from the fingers by a free use of methylated spirit.

Canada balsam is best preserved for use in the collapsible tin-tubes used for containing oil-colours. As already mentioned, air is largely absorbed by balsam; indeed, most varnishes dry quite as much by the absorption of oxygen as by evaporation. The advantage of the tube as a receptacle is that the balsam is kept quite close to the top of the tube, and no air allowed to remain there, so the balsam may be preserved in a perfectly fluid state for a long period. Balsam has been kept for two years in these tubes, and been as limpid as when the tube was filled; while, in bottles, the balsam rapidly hardens, and becomes useless if long kept. The tubes have also the advantage of cleanliness in use: the supply is obtained by squeezing out the quantity required, the use of a dipper, an endless source of dirt and introduction of foreign substances, being dispensed with. Should a little balsam ooze out around the screw-cap, it can be scraped away with a hot knife. These tubes also form convenient receptacles for varnishes which are liable to injury by being exposed to the air—such as gold-size. They do not answer for varnishes made with naphtha or spirit, as these varnishes dry entirely by evaporation, and soon fasten down the cap.

Solutions of balsam in various media have been much used by some microscopists. They have the advantage of allowing the mounting of an object to be effected without the employment of heat, a great desideratum in many cases. Chloroform has been the medium hitherto employed for dissolving the balsam, which is previously exposed to a slow heat, until it is dried into a hard, resinous mass. It has been found, however, that objects mounted in this solution have frequently become cloudy, and that the solution, if kept for a considerable period, becomes turbid. Dr. Bastian recommends the use of benzole as a solvent, on the ground of its greater stability. He has made great use of the solution as a medium for making preparations of nervous tissue. A detailed account of his processes will be found in the *Monthly Microscopical Journal*, vol. i., p. 94.

The solution of balsam and benzole is most conveniently kept in a wide-mouthed bottle, with a ground cap instead of a stopper, which will allow a small pipette to be kept in the bottle. Should the fluid become too thick from evaporation, a little more benzole may be added.

Besides the use of balsam as a mounting medium, it is useful as a cement for a special set of purposes. The microscopist who makes the osseous tissues, rocks, or hard substances in general his particular study, will often require thin sections.

The preparation of a bone section will serve very well as an example of section-cutting, and polishing in general. It is required to make a very thin section of a recent bone, polished on both sides, to be mounted dry. The bone is to be cut into thin slices with a watch-spring saw. A level surface is then to be made on one side, by grinding down with water on a piece of blue-stone, or Water-of-Ayr. If the slice is very rough, time may be saved by using a file in the first instance, and finishing on the stone. The fingers may be protected from the action of the stone by bedding the rough section in a piece of cork.

The bone slices are to be cemented with Canada balsam, by their ground sides, to pieces of thick plate-glass; 1¼ inches by ¾ of an inch is a convenient size for general use. The chief art consists in using the balsam of the right degree of hardness. A drop of balsam is to be placed on one of the slips, boiled on the hot plate, and allowed to cool. If, when cold, it is just capable of receiving a slight impression of the thumb-nail when pressed hard, it will do. If too soft, it must be heated again, and allowed to cool, and the process repeated, if necessary, until the right degree is obtained. If the balsam is not hardened sufficiently, it will clog the stone in the subsequent process; and, if too hard, it is liable to chip off along with the partially-finished section during the grinding. The piece of bone, cemented in its balsam bed, is to be ground down with water until the surface is levelled. It is then to be polished, so that no scratches appear upon it when examined under the microscope. This is done with putty-powder (oxide of tin, and not in any way connected with glaziers' putty), used with water upon a wash-leather strop. When the polishing is completed, the section is to be removed from the glass, which can be done by dropping it into a bottle of benzole, which will dissolve the hardened balsam, and release the section in a few minutes. A wide-mouthed stoppered bottle is convenient for this purpose, and the pieces of plate-glass are cut of the small size recommended, in order that they may be easily placed in and removed from the bottle. The half-finished section is now to be cemented to another balsam-bed, and ground down until it is sufficiently thin. With practice, 1-500th of an inch may be attained with a tough substance like bone. The author has approached this thickness even with fossil ganoid scales from the Weald clay. At first, it is well not to attempt too thin a section, and to practise on some material of which a large supply can be obtained. When ground sufficiently thin, the second surface is to be polished, and then detached as before, and afterwards washed in clean benzole, to remove all traces of balsam. The finished sections, when the benzole has dried off, are to be mounted dry by one of the usual processes.

Sections to be mounted in balsam will not require to be polished, as the balsam fills up, and, by its refractive power, apparently obliterates the scratches left by the grindstone. Other hard substances are treated in a nearly similar manner. Fossil bones and teeth, from their extreme brittleness, will require greater care in grinding, and, from their dark colour, must often be mounted in balsam, instead of dry. This is also necessary when they have a tendency to disintegrate. For very hard substances, such as teeth, the Arkansas stone would be of great service; but, unfortunately, it does not cut well when used with water, and, if oil is employed, the balsam is softened. A process devised by Dr. Christopher Johnstone about ten years ago, and published in *Silliman's Journal*, gives a process by which an oil-stone can be employed. The cement used is isinglass jelly, made with alcohol. Use is made of thin paper, as a guard against grinding away the section—an accident of frequent occurrence with beginners. The grinding is performed upon an Arkansas stone, with oil, and hot water is used to detach the section. The grease can be extracted with benzole. A detailed account of the process is given in the *Journal of the Quekett Microscopical Club*, 1869, p. 201. Accounts of the mode of cutting rock-sections, by J. B. Jordan, will be found in the same journal, p. 186, and, by D. Forbes, F.R.S, in the *Monthly Microscopical Journal*, vol. i., p. 240. The process of cutting sections of still harder substances, such as gems, is described by Mr, H. C. Sorby in the *Monthly Microscopical Journal*, vol. i., p. 220. Grindstones and polishing powders of various kinds can be obtained at the better class of tool shops, as Holtzapffel's, Buck's, Fenn's, &c.

Although it is the usual custom to cover slides containing dry and balsam mounted objects with paper, it is preferable to leave them without. A balsam-mounted preparation, well cleaned, and mounted on a piece of good patent plate with polished edges, is far neater than when covered with paper, which too often only serves to conceal an inferior quality of glass.

(To be continued).

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 5, 1869.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

"*On Nontronite*," by T. E. THORPE, Ph.D., communicated by Professor H. E. Roscoe, F.R.S., &c.

There exists some doubt among mineralogists as to whether nontronite is to be regarded as a distinct mineral species. Owing to the difficulty of obtaining it in a fit state for investigation, the few analyses hitherto published by Berthier, Dufrénoy, Jacquelin, and others, have taught us but little concerning its real nature. The following analysis, made on a comparatively pure specimen, may throw additional light on the constitution of this compound. The sample analysed was discovered, unclassified, in the Mineralogical Cabinet at Heidelberg, and was stated by Professor Blum, who was disposed to regard it as pinguite, to have been found in the neighbourhood of Heppenheim, in the Bergstrasse.

1·4155 grms. of the substance was heated with fuming hydrochloric acid until the mineral appeared to be completely decomposed. The solution was evaporated to complete dryness, and the separation of the silica effected in the usual manner.

Silica obtained, 0·5680 grms.

The weighed silica was then dissolved in caustic potash, and proved to be entirely free from sand or quartz.

To the filtrate from the silica were added a few drops of nitric acid, the solution boiled, and the iron precipitated by ammonia.

Ferric oxide, 0·5757 grm.

The weighed precipitate was next dissolved in strong hydrochloric acid, water added, and the solution filtered from a minute quantity of silica which had escaped separation by the previous evaporation.

Silica (not completely separated), 0·0030 grm.

Caustic soda was then added in slight excess to the filtrate, and the ferric oxide again precipitated, washed, ignited, and weighed. The re-precipitated ferric oxide weighed 0·5740 grm. Hence the substance was free from any appreciable quantity of alumina.

To the ammoniacal filtrate a few drops of ammonium oxalate were added, and the precipitate ignited, and determined as caustic lime.

Lime, 0·0380 grm.

On adding sodium phosphate to the filtrate, a mere trace of magnesia, appearing only after the lapse of some hours, was found.

The remaining constituent (namely, water) was determined by igniting the mineral in a stream of dry carbonic acid, carefully freed from air, until the loss of weight appeared constant.

1·1205 grms. substance lost 0·2311 grm. water.

Calculated from the foregoing analysis, the composition of the mineral is as follows:—

Lime	2·68
Magnesia	traces
Ferric oxide	36·44
Silica	40·30
Water	20·98
	100·40

On subtracting the lime, which evidently may be regarded as an unessential constituent, the percentage composition agrees very well with that required by the formula $Fe_2O_3 3SiO_2 + 5H_2O$.

	Found.	Calculated.
Ferric oxide ..	37·24	37·20
Silica	41·29	41·86
Water	21·47	20·94
	100·00	100·00

Nontronite is evidently a product of the decomposition by weathering of some siliceous mineral rich in iron. It possesses a light green colour, which, on the expulsion of water, changes to a dark chesnut-brown. It is perfectly opaque, and shows no evidence of crystallisation. Its fracture is uneven, and the lustre of its streak resinous. It is unctuous to the touch, and yields easily to the nail, and is somewhat harder than talc.

The following analysis by Biewend, made upon a specimen found at Andreasberg, agrees remarkably well with the foregoing determinations:—

Ferric oxide	37·30
Silica	41·10
Water	21·56
	99·96

Dr. SCHUNCK, F.R.S., called attention to a paper by Vogelsang and Geissler, on the nature of the liquids enclosed in certain minerals, such as rock crystal, topaz, and quartz, which appeared in the number of *Poggendorff's*

Annalen for last May. The authors find that these liquids (supposed by some observers to be hydrocarbons) always consist of liquid carbonic acid, mixed, in some cases, with a little water. The experiments by which they were led to this conclusion are fully described in the paper.

NOTICES OF BOOKS.

Elements of Chemistry: Theoretical and Practical. By William Allen Miller, M.D., LL.D., &c. Part III. *Organic Chemistry.* Fourth edition, with additions. Longmans. 1869. 976 pp.

Dr. Miller's works on chemistry have become so thoroughly classical in chemical literature, that, at first sight, it may appear almost unnecessary to notice a new edition of one of them; it will be well, however, as the work has been revised and a good deal augmented, to point out the more important changes and afterwards to give a brief account of the general arrangement and classification of the subject matter.

The principal changes in this edition consist in the uniform adoption of the new notation, together with the system of nomenclature first introduced by Berzelius, then abandoned, and now revived by Wurtz and Cannizzaro, and generally adopted in the chemical world. The metrical system of weights and measures and the centigrade thermometric scale have also, in this edition, been placed side by side with our own scales and measures.

The entire work is divided into fourteen chapters, which gives an average of about sixty-eight pages to each chapter, and there is a further sub-division of each chapter into "parts" and numbered paragraphs. The first and introductory chapter treats of "Organic Analysis, Classification of Organic Bodies, Metamorphosis, Synthesis." Now it has been a good deal contested whether we should not abolish the term "Organic Chemistry," since the old distinction has fallen to the ground, and more than a thousand substances once believed to be formed and capable of formation only in the organisms of plants and animals, have been synthetically prepared in the laboratory of the chemist. Hence, at the outset of this work, we find a statement of the difference between *organic compounds* and *organised bodies*, the former of which can, in many instances, be prepared synthetically, while the latter are "the result of the action of living bodies upon inanimate matter," and cannot be prepared synthetically. Sugar, oxalic acid, and urea belong to the class of "organic compounds," while muscular tissue and ligneous fibre belong to the class of "organised bodies." As to the line of demarcation between inorganic and organic products, this does not exist, still, as Dr. Miller observes, "it is convenient to sub-divide chemical compounds into organic and inorganic; since those derived from the inorganic world, from the greater simplicity of their composition, afford to the student the most favourable instances for examining the fundamental laws of chemical combination, before he proceeds to the investigation of the more complicated products obtained from the operations of the living plant or animal."

The account of the analysis of organic bodies is followed by remarks on the classification of organic compounds, in the course of which the theory of compound radicles and of the Polyad Elements are discussed.

Chapter 2 treats of "The Saccharine or Amylaceous Group: Different Varieties of Fermentation," and is divided into four parts. The first is devoted to an account of the different kinds of sugar, and in it will be found (pp. 110 and 111) an extremely useful table giving a list of the various sugars, together with the principal properties and distinguishing characteristics of each. The table commences with cane sugar, and ends with pinite, $C_6H_{12}O_5$, which has been extracted by Berthelot from *Pinus Lambertiana*; it is a readily soluble substance, with a very sweet taste, not fermentable, incapable of producing mucic acid with nitric acid, and producing right-handed rotation of a ray of polarised light. Part 2 treats of the varieties of starch and gum, and contains an admirable statement of the theory of the action of ferments. Part 3, "Cellulin and Woody Fibre," includes an account of coal and other combustible materials, and useful tables of the analyses of coals. Part 4, "On Fermentation," treats of alcoholic, lactic, and viscous fermentation.

Chapter 3, "The Monatomic and Diatomic Alcohols and Ethers," is divided into seven parts, and extends over 120 pages. It commences with an account of the monatomic alcohols, passing to the ethers, and to the action of chlorine on ethers and alcohols. Part 5 treats of the "Metallic Derivatives of the Alcohols," commencing with zinc-ethyl; then kakodyle, AsC_2H_6, which was the first substance of this class, and was obtained by Bunsen; the name is unfortunate, especially if we are to call it kakodylide of kakodyle—$(AsC_2H_6)_2$ or Kd_2—; we certainly prefer the name *arseniodimethyl, or arsendimethyl*. There are hundreds of compounds in chemistry which might be called kakodyl with as much reason as arsendimethyl. The practice of naming a substance from one of many characteristics which it has in common with other substances cannot be too much reprobated or too soon abandoned.

Chapter 4 treats of the triatomic alcohols; "the Fats and Fixed Oils and Glycerine." Chapter 5 of the "Products of Oxidation of the Alcohols—Acids." The third part is devoted to the fatty acids, and the fourth to certain other vegetable acids, where will be found a detailed description of the modifications of tartaric acid, and mention of the remarkable series of acids obtained by Löwig by treating oxalic ether with sodium amalgam.

Chapter 6, "The Amides and Organic Bases," contains a very detailed account of the organic bases, commencing with the volatile bases which do not contain oxygen, and first of aniline. Among the natural bases we find the cinchona alkaloids, cinchonia, cinchonidine, and cinchonicine; the alkaloids of opium, of the peppers, of the *Strychnos* tribe, and, of tea, coffee, and chocolate. Chapter 7, "Of Essential Oils and Resins," contains Part 1 of Essences, 2 of Resins, 3 of Glucosides. Chapter 8 "Of Colouring Matters," contains a list of colouring matters obtained from lichens, and on page 665 we find an "Assay of Lichens for Colouring Matter." The most striking peculiarity of the lichen acids would appear to be their power of etherifying alcohol.

Chapter 9 contains an account of the "Products of Destructive Distillation." Chapter 10, "Compounds of Cyanogen; Bases of Animal Origin; Uric Acid and its Derivatives." The cyanides are divided into two classes—"Cyanides which do not contain Electro-negative Metallic Cyanides," among which are the zincic, plumbic, and palladious cyanides, and into "Cyanides which contain Electro-negative Metallic Cyanides," among which are the ferro- and ferri-cyanides, the nitroprussides, cobalticyanides and iridicyanides. Chapter 11, "Albumenoid and Gelatigenous Principles." Chapter 12, "Chemical Properties of some of the Solids and Fluids of Animal Origin;" and Chapter 13, "On the Nutrition of Plants and Animals." The two last chapters, which, together, extend over nearly 100 pages, will be of special use to medical students and those who devote themselves more particularly to physiological chemistry. Herein are discussed the chemical nature of—(1) the solid constituents of animals—bones, shells, horny matter, fibrous and elastic tissues, and of the components of the brain; (2) "Some Important Animal Fluids"—blood, chyle, lymph, milk, &c.; (3) the liquids concerned in digestion—saliva, gastric juice, bile, with a table of bile products; (4) excrementitious products—urine, excretin, and pus.

The fourteenth and final chapter is devoted to a discussion of "Atomic Volumes, and the Law of Boiling Points," and contains a number of useful and important tables. The first of these (pp. 941-944) shows the

density of a number of compound gases and vapours, and is arranged in the following order:—Name of compound, constituents, formulæ, density, calculated when H = 1 and when Air = 1, and observed in the latter case, and the authority. Next a table (p. 927) of the atomic volumes of elementary bodies; then the atomic volumes of certain oxides, sulphates, chromates, tungstates, carbonates, and nitrates, and of liquids of analogous composition. The remainder of the chapter is devoted to Kopp's law of boiling points. The fundamental proposition of this law is, as is well known, that for every addition of CH_2 in the empirical formula of compounds of ethyl and methyl, a rise of temperature of about 20° C. takes place in the boiling point; it has further been observed, as a general result of observation, "that the boiling point of a normal acid is 63° C. higher than that of its methylic ether, 44° C. higher than that of its ethylic ether, and 13° C. lower than that of its amylic ether; the boiling point of an alcohol of the form $C_nH_{2n+2}O$; is about 40° C. lower than that of its corresponding acid $C_nH_{2n}O_2$; a compound ether of the form $(C_nH_{2n+1}C_nH_{2n-1}O_2)$ boils at about 82° C. below the acid $(C_nH_{2n}O_2)$ which is isomeric with it." It is notorious, however, that very considerable discrepancies have been observed as regards the accuracy of Kopp's law, whether arising from inaccuracy of observation or from a defect in the law remains to be proved. Kopp has well observed in regard to these discrepancies "that it must not be assumed that the boiling points of liquids, when compared at *any* given pressure, will always exhibit the same differences as they do when compared at the average pressure of 30 inches (760 m.m.) of mercury. It does not follow, for instance, though the boiling point of ether is 79·5° below that of alcohol under a pressure of 30 inches, that under a pressure of 15 inches, the difference between these boiling points should still be 79·5°; since it is well known that what is called Dalton's law, viz., 'that all liquids at equal distances from their boiling point emit vapours of equal tension' is not correct."

The excellence of Dr. Miller's "Organic Chemistry" is so well recognised that it does not require one word of praise here. The very fact of its having reached a fourth edition (which is the fate of few large chemical works in this country), speaks for itself. Since Dr. Miller is constantly engaged in the teaching and the practice of chemistry, we are insured in his works the very newest matter, whether of theory or experiment. Thus we notice, in this edition, an account of the very recent researches of Messrs. Matthiessen and Wright on morphia and codeia. The constant reference to researches is of especial value, and if the year were more often added to the number of the volume and page of the work quoted, would be of still greater service. We regret to notice a somewhat large list of *errata* for a fourth edition, for although the corrections may be made once for all in ink, a work is always somewhat disfigured thereby. The use of a variety of types is now becoming more or less general in scientific works, especially on the continent, and when this can be done it certainly greatly facilitates reference; the broad thick letters and numbers are specially useful for the heads of paragraphs, while salts may be advantageously printed in small capitals, or with some other distinctive type characteristic: if in a later edition of the work we are considering this could be done, we think it could be consulted with greater readiness. We are almost surprised to find that Dr. Miller, whom we have been wont to account one of the more conservative chemists, has not only fully adopted the changes in the atomic weights and in the formulation of compounds, but has also introduced the changed names of substances, or, at least, one set of changed names. Thus it surprises us to find him speaking of "Plumbic Chloride," "Zincic Oxide," "Sodic Sulphate," and "Palladious Cyanide." The adoption of these terms by so eminent an authority will do much towards making them universal in the chemical literature of this country. We cannot help thinking sometimes, when we notice the extent and the variation of these changes, of the future of chemistry. If the science progresses in the next quarter of a century as much as it has in the last quarter (and there seems no reason to doubt that it will), there must of necessity be great and portentous changes. We cannot yet treat the facts of chemistry in a dogmatic and final manner. We cannot lay down such propositions as did Euclid of geometry; there is no absoluteness at present in our science; there is nothing of which we can speak with the same precision as we speak of the relation of the circumference of a circle to its diameter. And so long as this is the case some are of opinion that any changes tending to produce complexity should be avoided until their adoption has become, by the general consent of the chemical world both at home and abroad, a matter of absolute necessity.

CORRESPONDENCE.

BLOWPIPE CHEMISTRY.

To the Editor of the Chemical News.

SIR,—In my letter of the 17th of June, to your address, I state as follows:—"I reflected, however, that borax, being a compound salt, could scarcely be expected to give uniform results chemically, either as regards crystallisation or any other operation." The same reflection, together with a strong wish to obtain trustworthy reactions by the blowpipe through which the alkalies and alkaline earths could be detected, led me to try the colouration of Co solution with pure boracic acid, adding the alkali or earth to be experimented upon by traces at a time. I succeeded beyond my utmost expectation; the CoO, indeed, was scarcely at all dissolved in the pure BO_3; but I observed with my magnifying-glass spots of deep red-violet colour upon the cooler part of the platinum wire, which promised good results; and I found that, upon the addition of a trace of potash or soda, taken up on the hot bead, the CoO quickly dissolved, producing, in both cases, a pretty but light pink colour. I then generally (for I have made hundreds of experiments, with the detail of which I will not fatigue you) took upon the bead one more drop of Co solution, which deepened the pink colour, and showed a fine mauve-blue while hot. By the gradual addition of soda ($NaOCO_2$) to this, both the hot and cold beads were deepened in their tints, the former showing, for a moment, a deep blue-violet, and the latter remaining a splendid violet or purple colour. At last, the bead thus treated remains blue, both while hot and cold, and the amount of Na taken to effect this shows, I presume, pretty exactly that contained in borax.

The boracic acid cobaltine bead, treated in a similar way with potash, shows the same series of colours, but the potash blue is deeper, and has a dark violet tinge in it, which the soda blue has not, except when held against the flame of the lamp. On the addition of soda to a potash cobaltoboracic acid bead, this violet-blue is not changed, but even deepened; and the addition of potash to soda in a similar bead has a like effect. The addition of carbonate of lime to a boracic acid bead, with a drop of Co solution, produces a mauve-blue, opaque bead, magnesia a lavender-blue, opaque bead, both going through the gradations of pink, &c.

Fluor spar produces a clear bead; after a time, mauve-blue; so that the fluorine assists the boracic acid to dissolve the lime. Magnesia, assisted by a trace of potash or soda, may, by gradual addition, be made to go through the usual gradations of pink, &c., in a clear bead, until a mauve-blue is attained.

It will be proper here to detail two experiments showing the quantity of potash and soda taken respectively to satisfy an equal quantity of BO_3.

(1). "Measured very carefully half of 5 measures of BO_3, forming a bead about three-fourths the diameter of glass tube. Filled five measures with $NaOCO_2$; took a trace on hot bead, and added drop of Co solution; light pink, no undissolved Co discernible. Another drop Co solution; mauve hot, amethyst colour cold. Another trace Na; blue-mauve hot, dark purple cold. Trace more Na; lime-blue hot, blue-purple cold. Trace Na; deep mauve-blue hot, deep purple-blue cold. More Na; a little darker colours than before. More Na; mauve-blue. More Na; held against a bead of cobaltine borax, the blue still appeared mauve. More Na; not borax-blue yet. More Na; cobalt borax-blue. It took three-fourths of 5 measures (75 milligrammes); but, as it was a hydrated salt, containing, I should think, half its bulk in HO, I took half of this, or 35 milligrammes, to be the amount of $NaOCO_2$ taken to satisfy 50 milligrammes of boracic acid.

(2). Took half of 5 measures to form BO_3 bead, same size as last. Added drop Co solution and trace of $KOCO_2$ from 5 measures; pink, deeper than soda first trace. Added trace KO; light mauve hot, and light pink cold. Added drop Co solution; dark mauve hot, darkish purple cold. Trace KO; very dark blue hot, dark violet cold. Trace KO; dark mauve-blue hot and cold. Trace more KO; darker blue than last. Trace more KO; deep violet-blue, potash-blue. Took half of five measures (50 milligrammes), and, as it was also a hydrated salt, with less HO than the other, I estimated the quantity taken to satisfy the BO_3 as three-fourths of that, or 37·5 milligrammes; but I consider that too much, as I overdid the blue colour, and the KO was evidently more energetic in combination with BO_3 than Na, so that I should think it forms, with that acid, a triborate. I cannot procure caustic soda here, or would not have experimented with the carbonates of those alkalies.

(3). Filled five measures again, and took half to form a bead of BO_3, same size as before. (NB.—The loops of my platinum wires are all twisted of the same diameter). Filled five measures with $CaOCO_2$. Added trace Ca to boracic acid bead, with one drop Co solution; bead pinkish, with undissolved Co in spots. Trace Ca; opaque, lavender bead. Trace Ca; bead still opaque, of a blue-lavender colour, with spots of undissolved CoO, so added trace KO to clear it, and added trace BO_3 to make up for the KO; bead dark amethyst. Trace Ca; dark mauve hot, dark amethyst cool. Trace Ca; the mourning-violet colour cool. Trace Ca; deeper colour. Trace Ca; dark violet-blue, lime-blue. Took three-fourths of 5 measures (NB. This powder was extremely fine and dry, so that the above amount, 75 milligrammes, is, if anything, too little). I then made every effort, trying carbon, crystals of a solution of boracic acid in nitrate of cobalt, &c., to get the BO_3 to dissolve the CoO without the addition of an alkali, convinced, if I succeeded, I should get the beautiful wine-red or blood-coloured purple I had observed on the cool part of the platinum wire. I plunged the hot bead into cold water to cool it; I placed two small pieces of platinum wire in its centre for the same purpose, but without effect; and, as you will see from what follows, I found that BO_3 even acted as an alkali itself. Its energies are certainly feeble, and, even with a little KO, it failed to dissolve Cr_2O_3.

Reasoning analogically, I now concluded, as microcosmic salt gave a blue with Co solution not to be distinguished from that of borax, to attempt similar experiments to the above with pure or glacial phosphoric acid. I thought, at first, that I should have to make this myself, but was lucky enough to find two kinds in a chemist's shop here, who uses it in the preparation of some food. The kind which looked the purest, being like ice, I found, on being heated, gave off a smell of ammonia, and became so fluid as to drop off the platinum wire. I applied Co solution to what remained, and it immediately became blue—I presume, from the soda contained in the bones from which it was made. The other, in sticks like those of phosphorus, acted most energetically, and at once dissolved almost any quantity of CoO to a magnificent red-purple bead—the very colour I tried to get out of BO_3 and CoO in vain. On mixing BO_3 with this red-purple bead in considerable quantity, I obtained a blue, so deep that it appeared opaque, but, once seen, far surpassed in splendour of colour that of cobaltine borax.

I have not space or time to relate now my experiments with PO_5; but one fact is too important to omit, viz., that, with a slight trace of MnO_2 in the phosphoric bead, I obtained, by the persistent addition of soda, a rich brown colour, without any amethystine tinge, while potash gave, with the same oxide, an amethyst, with a far more purple tint than that of either the borax or microcosmic bead does with manganese.—I am, &c.,

W. A. Ross.

Simla, July 15th, 1869.

MISCELLANEOUS.

Glycoblastol.—Under this name there has been brought out at Vienna a cosmetic to be applied to the hair. It is simply made up of glycerine which has been digested with the rind of capsicum and perfumed with patchouli. As glycerine is by no means a proper substance to be applied to hair, this cosmetic, which is sold at an exorbitant price, ought not to be employed.

Fluid Glue.—To 1 kilo. of best glue dissolved, by the aid of a gentle heat, in 1 litre of water, 0·2 kilo. of nitric acid at 36° Beaumé (sp. gr. 1·334). After the at first rather strong evolution of nitrous acid vapours has ceased, the liquid is cooled and fit for use; a better product is obtained when dry clear glue (so-called gelatine) is treated and dissolved on a water-bath in its own weight of strong vinegar, one-fourth of its weight of alcohol, and a very small quantity of alum.

Elastic Glue.—Glue is dissolved in water by the aid of a water-bath, and evaporated until quite a thick fluid is obtained; to this a quantity of concentrated glycerine is added, equal in weight to the quantity of glue taken, and the evaporation is continued, while the mixture is frequently stirred, in order to drive off the remaining water; the mass is then run upon clean marble slabs, and cooled. This material is usefully applied for the inking-rollers of printers, and various other purposes.—*Deutsche Industrieblätter.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, October 18, 1869.

This number contains the following papers bearing upon chemistry and allied sciences:—

Metrical System: Critical Examination of the History of the Metre.—M. Chevreul.—From this lengthy paper we learn that, on the 14th of April, 1790, M. Brisson was the *savant* who proposed that a unit of measure should be taken from nature, by reading, at the Academy of Sciences, a paper "On the uniformity of measures of length, capacity, and weights, and on a new method of constructing the toise to be used as a standard." This paper of M. Brisson was written in consequence of the proposal made by the Bishop of Autun, as a member of the National Assembly, to render a uniform system of weights and measures compulsory by law throughout the entire French kingdom. The unit of measure of length proposed by M. Brisson was the length of the pendulum beating seconds at the latitude of Paris, which length had been very exactly determined by M. de Mairan, and found to be equal to 3 *pieds*, 0 *pouces*, 8 17-30ths *lignes*,

French measure. The Commission des Poids et Mesures, which was appointed after M. Brisson had made his proposal, preferred the 10,000,000th part of a quarter of the meridian of Paris as unit. The law of the 18th Germinal of the year III. (April 7, 1795) fixed the length of the metre, provisionally, at 3 *pieds*, 11·442 *lignes*. The law of 6 Messidor, year VIII. (June 25, 1800), fixes the length of the metre at 3 *pieds*, 11·296 *lignes*; the difference being −0·146. This length is the legal length of the metre, and is represented by an *étalon prototype* (invariable standard) deposited with the Academy. From 1836 to 1840, M. Puissant found there was an error in the calculation of the meridian distance of Montjouy to Formentera; and, accordingly, he found that the length of the metre should be 3 *pieds*, 11·375 *lignes*. The author of this paper comes to the conclusion, however, that, notwithstanding the slight errors found by MM. Puissant, Bessel, and others, the length of the standard metre, which is only 0·079 *lignes* different from the truth, is to be adhered to, also because of the very great inconvenience any change would cause, which is, after all, not essentially required for the uses of daily life.

Making of Standards of the Metrical System.—M. Jacobi.—This Russian *savant*, who, during his sojourn at Paris, was present at this meeting, read a paper on this subject, with the view of generalising the metrical system by the preparation of a large number of new standards made according to those deposited with the Academy, so that every centre of civilisation in Europe and elsewhere may possess one.

Oxidation of Pyrogallic Acid.—M. Aimé Girard.—The author of this paper points out that, when pyrogallic acid is oxidised in the presence of an acid, the products of its oxidation are different from those which are formed when the oxidation takes place in the presence of an alkali. Among the products there is one, $C_{30}H_{18}O_{18}$, which is a beautiful red-coloured substance, analogous to alizarine, and suitable to be used as a dyeing material. This substance is converted into picric acid by the action of nitric acid.

On Esmarkite.—M. Des Cloizeaux.—Esmarkite is a greyish-green coloured mineral; its fracture is conchoid; hardness holds the middle between apatite and orthose; sp. gr., 2·737. Composition, in 100 parts:—Silica, 47·50; alumina 33·70; lime, 15·40; magnesia, 0·56; soda, 1·84; potassa, 0·59; water, 0·94.

Observations of M. Victor Regnault on a Letter from Dr. Bosscha.—This lengthy paper contains a large amount of valuable matter in reference to thermometers, and among it the following:—The mercurial thermometer is not an instrument fit for being applied to the measurement of temperatures in experiments of precision, since it is not comparable (*manque de comparabilité*). Every mercurial thermometer which is to be applied for rigorously-exact experiments should be previously compared with a well-constructed air thermometer, both for degrees of temperature between 0° and 100°, as well as for higher temperatures. The learned author distinguishes three kinds of mercurial thermometers, viz.:—Standard thermometers, indicating from −10° to +110°; thermometers for high temperatures, graduated from −10° to +350°, but which should not be exposed to a heat higher than 300°; very sensitive thermometers for calorimetrical use, indicating from 0° to +30°. The mercurial thermometer is only a thermoscope; its indications should be converted into degrees of an air thermometer.

Electro-Chemistry: Physical Method to Determine the Molecular Groups which are Decomposed by a Galvanic Current.—M. Bourgoin.—According to this author, the electrolytic decomposition suffered by any compound indicates the grouping of the molecules of which that compound is made up; for instance, when sulphate of soda is decomposed by a galvanic current, it becomes evident, from the products of the decomposition, that the anhydrous salt has suffered dissociation, but not its hydrate; in other words, that the water remains inactive in this process.

Cause of the Ripening of Wines.—M. Béchamp.—The author demonstrates in this paper, at great length, that the same causes which bring on the decay of wine also act in maturing them, and giving them the precious properties recognised as *old*. It is impossible to enter into the details of this subject, which is, of course, practically important only to wine-growing countries; but it appears, after all, that scientific research on this subject is not yet quite exhausted, neither has it so elucidated this matter as to render it of easy practical application.

The American Journal of Science and Arts, vol. xlviii., No. 143, September, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Nature and Duration of the Discharge of a Leyden Jar Connected with an Induction Coil.—Mr. O. N. Rood.—This paper is the first part of a memoir read before the National Academy of Sciences. It is copiously illustrated with well-executed woodcuts, which are essential to the understanding of the paper.

On Durangite, a Fluo-Arsenate from Durango, in Mexico.—Mr. Brush.—The author states that he obtained, from a gentleman residing at San Francisco, a bright orange-coloured mineral found at the locality above named. The hardness of this mineral was 5, sp. gr. 3·95 to 4·03; it blackens on being moderately heated in a close tube, but regains its colour again on cooling; at a higher heat it fuses to a yellow glass, and gives a faint white sublimate; it fuses readily in reducing flame, gives a strong arsenical odour, and coats the charcoal with a faint white volatile sublimate. The mineral is only partially attacked by chlorhydric and nitric acids, but is completely decomposed by sulphuric acid, with evolution of fluorhydric acid. Qualitative examination showed the presence of arsenic acid, alumina, iron, manganese, soda, lithia, and fluorine. Search was made for other metallic and mineral acids and chlorine with negative result. The following is the result of quantitative analysis in 100 parts:—Arsenic acid, 55·10; alumina, 20·68; peroxide of iron, 4·78; protoxide of manganese, 1·30; soda, 11·66; lithia, 0·81; fluorine, undetermined, but present in very considerable quantity.

Remarks on the Galvanic Battery.—Mr. Hough.

On Nitric Acid and Chlorate of Potassium as an Oxidising Mixture Applicable to Sulphur, Sulphides, Chromium, Arsenic, and Organic Matters.—Mr. F. H. Storer.—This interesting paper will soon appear in full.

Action of Light on Uranium.—Mr. Bolton.—This memoir contains an historical and experimental review of whatever is known in relation to the action exercised by light upon uranium. The paper is too lengthy for any useful abstraction.

Action of Alkaline Nitrites upon Uric Acid and its Derivatives.—Dr. W. Gibbs.—After referring to the labours of M. Baeyer on this subject, the author describes, at great length, a series of experiments made by him. This paper has, however, been forestalled by a communication of the author written to Berlin, and abstracted by us from the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin* (see CHEMICAL NEWS, vol. xx., p. 131). The original paper was read before the National Academy of Sciences on April 15th last.

On the Meteoric Stone which fell December 5th, 1868, in Franklin Co., Alabama, U.S.—Mr. Brush.—This paper first relates, at length, the history of the circumstances attending the fall of this stone, which, on being received by the author, weighed 615 grms.; sp. gr., 3·31; soluble in HCl, only about 26 per cent. Result of analysis, in 100 parts:—Silica, 51·33; alumina, 8·05; ferrous oxide, 13·70; chromic oxide, 0·42; magnesia, 17·59; lime, 7·03; soda, 0·45; potassa, 0·22; sulphur, 0·23; a trace of nickeliferous iron.

On Lesleyite of Chester Co., Penn., and its Relations to Ephesite of the Emery Formation near Ephesus, Asia Minor.—Mr. Smith.—The author states that some years ago he analysed and described, mineralogically, under *emery*, the last-named mineral. The lesleyite has great similarity therewith. It is of a pearly white colour, and lamellar in structure; scratches glass easily; sp. gr., 3·15 to 3·20; heated before blowpipe, it becomes milk-white, but does not fuse; it is decomposed with great difficulty, by fusing, by carbonate of soda, even with the addition of a little caustic soda. Ephesite, in 100 parts, contains:—Silica, 30·70; alumina, 55·67; lime, 2·55; soda, 5·52; potassa, 1·10; water, 4·91. Lesleyite, in 100 parts:—Silica, 31·18; alumina, 55·00; lime, 0·45; soda, 1·20; potassa, 7·28; water, 4·80.

Artesian Well at Terre Haute, India.—Prof. Guyot.—Under the direction and at the expense of M. Chauncey Rose, a well has been bored, and a very exact account has been made of the thickness of the strata passed through and of the fluids met with:—At 840 ft., show of oil; 1276 ft., lubricating oil; 1335 ft., vein of fresh water; 1629 ft., oil vein; 1658 ft., blue sulphur water; 1710 ft., white sulphur water; 1768 ft., more white sulphur water; 1785 ft., large flow of white sulphur water, at the rate of 6000 gallons an hour. The temperature of the water at that depth is not quoted, neither is any further account given thereof; there is no statement, also, of the height above sea level of the surface of the bore-hole on the ground.

Sulphur Deposits of the Island of Saba, Netherlands West Indies.—Mr. Higgins.—The island of Saba belongs to the volcanic range of the Carribee or Windward Islands. The rock composing almost the entire formation of Saba is trachytic porphyry, which contains glassy felspar and hornblende in crystals, disseminated through a dark reddish coloured base. The sulphur deposit is located on the northern part of the island of Saba, and extends for a distance of more than a mile along the sea line. The stratum of sulphur varies in thickness from 15 to 50 feet; its elevation above sea level varies from 45 to 200 feet. This island has a surface of 16·5 square kilometres (about 9 English square miles, or 5760 acres), and contains 1794 inhabitants; it has been a Netherlands dependency for nearly 200 years, and is a portion of the Government of Curacao, along with Aruba, St. Martin (a portion), Bonaire, and St. Eustatius.

Journal für Praktische Chemie, No. 12, 1869.

This number contains the following original papers:—

Analysis of the Medicated Spring of Tönisstein, and of the Chalybeate Spring at the same place.—Dr. R. Fresenius.—To many of our readers who have made a trip on the Rhine, the Brohl-Thal will have been a pleasant excursion, and to those who made that trip, the two springs just alluded to will be well known. The author of this paper has divided it into two chief sections and several subdivisions. The medicated spring of Tönisstein has been known even so far back as the time when the ancient Romans occupied that country; and in the year 1864, the Prussian Government caused the spring to be properly cleansed out, and, by means of suitably-arranged masonry and tubing, to exclude any extraneous water. The water of this spring, which is evidently forced up by a pretty strong pressure of a constant stream of carbonic acid gas, is quite clear and very sparkling, owing to the carbonic acid gas constantly escaping from the spring; its taste is pleasant, but at the same time saline. The spring yields, on an average, 4908 litres of water in twenty-four hours, while, at the same time, there escapes a quantity of 650 litres of free CO_2; the temperature of the water was found to be 10·8°, while the temperature of the air was, at the time of making the experiment, 19°; the specific gravity of the water at 15° is 1·00598. The author made, first, a very carefully executed qualitative analysis of this

water, and then a quantitative analysis, the results of which are quoted in duplicate—in one case, the carbonates have been calculated as neutral salts; in the other, they are calculated as anhydrous bicarbonates. For each analysis, moreover, the quantities are expressed in duplicate—that is to say, first, upon 1000 parts of water; next, in grains, at 7680 to the Prussian pound. Upon 1000 parts of water, the carbonic acid salts being calculated as anhydrous bicarbonates, there are contained in this liquid:—Sulphate of potassa 0·09900: sulphate of soda, 0·14763; chloride of sodium, 1·41489; iodide of sodium, 0·00001; bromide of sodium, 0·00080; nitrate of soda, 0·00046; phosphate of alumina, Al_2O_3,PO_5, 0·00013; phosphate of soda, $2NaO,HO,PO_5$, 0·00018; bicarbonate of lithia, 0·00622; bicarbonate of soda, 2·57546; bicarbonate of ammonia, 0·00777; bicarbonate of baryta, 0·00008; bicarbonate of strontia, 0·00007; bicarbonate of lime, 0·55116; bicarbonate of magnesia, 1·63697; bicarbonate of protoxide of iron, 0·02949; bicarbonate of protoxide of manganese, 0·00043; silica, 0·02741. Total solid matters, 6·49816; free, that is to say, non-combined carbonic acid, 2·39334. The following substances are present in this water in quantities too small for determination by the balance:—Fluoride of calcium; borate of soda; organic matter, a mere trace; nitrogen, a mere trace. The Tönisstein chalybeate spring yields, on an average, a quantity of 9072 litres of water every twenty-four hours; this water, on being taken at the spring, is a quite clear, briskly-sparkling, refreshing liquid, yet at the same time ferreous to the taste. There escapes along with the water a considerable quantity of free carbonic acid gas, which amounts to some 6·840 litres during twenty-four hours. The temperature of the water of this spring was found to be 11·5°, while at the time this observation was made, the temperature of the air was 18°; the specific gravity of this water at 15° is 1·00270. 1000 parts of this water contain (the carbonates being calculated as bicarbonates):—Sulphate of potassa, 0·05444; chloride of potassium, 0·03575; chloride of sodium, 0·00911; nitrate of soda, 0·00102; phosphate of soda, 0·00040; phosphate of alumina, 0·00045; bicarbonate of lithia, 0·00048; bicarbonate of soda, 0·80325; bicarbonate of ammonia, 0·00410; bicarbonate of baryta, 0·00011; bicarbonate of strontia, 0·00156; bicarbonate of lime, 0·54075; bicarbonate of magnesia, 1·08154; bicarbonate of protoxide of iron, 0·05097; bicarbonate of protoxide of manganese, 0·00372; silica, 0·04107; entirely free CO_2, 2·33600. Total, 5·05382. The following substances are present in unweighable quantities:—Fluoride of calcium, iodide and bromide of sodium, organic matter, borate of soda, and nitrogen; of all merely traces.

Analysis of the Lamscheid Mineral Water.—Dr. R. Fresenius.—This paper is not a sterile account of a chemical analysis, but contains, as introduction, a most interesting historical review of a very anciently-known and renowned mineral spring, situated on the so-called Hundstrück, at an elevation of 1100 feet above the level of the Rhine, taken at Boppardt, and on the great Chaussée, leading from the last-named place towards Simmern and Trier, at a distance of about 12 miles from the Rhine. The water bubbles up from a deep depression in Thonschiefer; the well is properly provided with masonry, to protect it from the entrance of extraneous water. The physical qualities of this water are the following:—Perfectly colourless, briskly sparkling, taste very refreshing, acidulous, somewhat ferruginous, and no smell. The well yields, in 24 hours, about 14,000 litres of water; its temperature is 10·2°, when the temperature of the air is at the same time 20°. The specific gravity of this water at 23·7° is 1·00147. The quantitative analysis of this water, its carbonic acid salts being calculated as bicarbonates, yields, for 1000 parts, the following results:—Sulphate of potassa, 0·004918; sulphate of soda, 0·006905; chloride of sodium, 0·005869; bicarbonate of soda, 0·070088; bicarbonate of lithia, 0·001279; bicarbonate of ammonia, 0·000795; bicarbonate of lime, 0·547639; bicarbonate of baryta, 0·000367; bicarbonate of strontia, 0·000074; bicarbonate of magnesia, 0·207382; bicarbonate of protoxide of iron, 0·071386; bicarbonate of protoxide of manganese, 0·006677[1]; phosphate of alumina, 0·000460; alumina combined with silica, 0·000034; silica, 0·034456; free, that is to say, entirely uncombined carbonic acid, 2·818499. Present in this water, but in too small quantity for estimation, are:—Nitrate of soda, iodide and bromide of sodium, organic matter, and nitrogen, all mere traces. The author quotes in this, as well as in the immediately preceding paper, a very interesting series of analyses of other mineral waters, for the sake of comparison. Space forbids us to abstract or quote these particulars here; suffice it to say that the Lamscheid mineral water is a most excellent chalybeate, and quite equal to the celebrated chalybeate of Pyrmont.

Asparaginic and Glutaminic Acids.—Dr. Ritthausen.—Among the products of the decomposition by the action of strong sulphuric acid upon legumine and conglutine, the latter substance being the proteine compound met with in almonds and lupines, the author discovered asparaginic and glutaminic acids, and, moreover, a substance the nature of which has not been further investigated. In this essay, the investigation of this subject, commenced some time ago, is fully described. Asparaginic acid exhibits a crystalline body, belonging, in that respect, to the rhombic system, soluble in water and alcohol, and consisting, in 100 parts, of:—C, 36·09; H, 5·26; N, 10·53; O, 48·12. Formula, $C_4H_7NO_4$. This acid, which yields, with the oxides of copper and silver, and also with baryta, well-defined salts, is converted, by the action of nitric acid, into malic acid, $C_4H_6O_5$. Glutaminic acid, $C_5H_9NO_4$, when pure, also exhibits crystals belonging to the tetrahedric rhombic system; soluble in water and alcohol; converted into glutanic acid, $C_5H_8O_5$, by the action of nitric acid.

Asparaginic Acid as a Product of the Decomposition of Animal Proteine Compounds.—Dr. Kreusler.—This author has undertaken, for animal proteine compounds, an investigation of a similar nature as Dr. Ritthausen has done for vegetable proteine substances. The writer of this paper has applied, for his researches, caseine from milk, albumen from eggs, and vitelline from the same. These substances were treated separately with a mixture of 3 parts of concentrated sulphuric acid and 6 parts of water to 1 part of substance; the boiling was continued for eight hours. After the necessary purifying process, and the use of oxide of copper to form salts, the author discovered, with perfect certainty, that asparaginic acid is formed in this instance; but glutaminic acid could not be detected. Animal horn, when treated with sulphuric acid, also yields asparaginic acid.

Analysis of the Iodine Containing Water from the Mineral Spring at Roy, near Freistadt, Silesia.—Dr. Redtenbacher.—10,000 parts of this water contain:—Chloride of sodium, 219·680; chloride of potassium, 2·062; chloride of calcium, 21·384; chloride of magnesium, 7·740; bromide of magnesium, 1·016; iodide of magnesium, 0·319; carbonate of magnesia, 1·832; carbonate of protoxide of iron, 0·505; free carbonic acid, 0·594; silica, 0·554; organic matter, 0·432; total of solid substances, 251·6. The iodine spring at Halle contains:—Bromide of magnesium, 0·584; iodide of magnesium, 0·426. The iodine spring at Luhatschowitz contains:—Bromide of magnesium, 0·116; iodide of sodium, 0·237. For both these last springs, the quantities quoted refer to 10,000 parts of water.

Annalen der Physik und Chemie, von Poggendorff, No. 9, 1869.

The following are original papers in this number:—

New Spectroscope, and Contributions to the Spectrum Analysis of the Stars.—M. Zöllner.—The author describes what he calls a reversion spectroscope, and elucidates its mode of action by relating at length a series of observations made by him with this instrument.

Thermo-Chemical Researches.—M. Thomsen.—The basis of this lengthy essay is thus set forth:—Different acids, when neutralised with the same base, evolve unequal quantities of heat; when, therefore, any acid displaces another acid from its combination with that base, this decomposition will be accompanied, either by an evolution of heat or by an absorption of heat, according to the greater or less heat of neutralisation possessed by the free acid or the acid of the salt. The quantity of heat thus evolved or absorbed affords a measure for the degree of decomposition.

Combinations of Alcohol and Water.—M. Mendelejeff.—This paper contains a review of almost every point worthy of notice bearing upon the history of the accurate determination of the density, contraction, and areometrical assay of mixtures of water and alcohol at various temperatures. Another portion of this paper is an essay on the determination of the specific gravity of liquids; to this portion is added the description of a very ingeniously-contrived and neat apparatus, applied for the purpose of taking the specific gravity of liquids, illustrated by a woodcut.

Constant Capillarity of Fused Chemical Compounds.—M. Quincke.

Specific Heat of Air when Kept at a Constant Volume.—M. Witte.

Observations on the Chemical Constitution of Plagioklastic Felspar.—M. Tschermak.—The author does not explain the term *plagioklastic*, but he says the chemical composition of plagioklastic felspars is such that they exhibit isomorphous mixtures of two chemical compounds. [Our readers are reminded that felspar is a mineral of which there exists a great number of varieties; orthoklase, or potash felspar, is $KO,SiO_3+Al_2O_3,3SiO_3$.] The chemical composition of the varieties of this mineral oscillates between two extremes, viz.:—Albite, $Na_2Al_2Si_6O_{16}$, in 100 parts:—Silica, 68·6; alumina, 19·6; soda, 11·8. Anorthite, $Ca_2Al_4Si_4O_{16}$, in 100 parts:—Silica, 43·0; alumina, 36·9; lime, 20·1. The author, who is an eminent mineralogist, enters into a lengthy discussion on the mineralogical characters of felspars, and sharply criticises the labours of some other mineralogists; it appears, however, that the chemical analysis of minerals of complicated composition is not a matter of mathematical certainty. As a proof, the author quotes two analyses of the self-same identical substance, made by two noted chemists, wherein the difference of silica amounts to +2·30 per cent; alumina, −1·95 per cent; lime, +0·53 per cent; soda, −1·44 per cent.

Labradorite from the Närödal.—M. vom Rath.

Elements of Terrestrial Magnetism for Göttingen, July 9, 1869, and the Secular Variations.—M. Cohlrausch.—At latitude 51° 31′, 8 N., longtitude east of Greenwich 9° 56′, 6, the westerly declination of the magnetic needle was, on the above date, 14° 51′, 7; the inclination, 66° 47′, 4; horizontal intensity, 1·8412.

Reflection of Heat on the Surface of Fluor Spar and other Substances.—M. Magnus.—From this memoir we learn that the following substances reflect, at an angle of 45°, the undermentioned quantities of heat:—Silver, between 83 and 90 per cent; glass, between 6 and 14 per cent; rock-salt, between 5 and 12 per cent; fluor spar, between 6 and 10 per cent.

This number contains some papers which have been translated from the *Proceedings of the Royal Society*.

Moniteur Scientifique, October 15, 1869.

This number contains, among its original communications, the following:—

Manufacture of Alkaline Carbonates, and of Carbonate of Lead, and also other Carbonates, by means of a New Chemical Action.—M. Puissant.—When carbonate of baryta in finely-divided powder is suspended through water wherein, simultaneously, a proportional quantity of sulphate of soda is dissolved; and there is next passed through the liquid a current of carbonic acid, which is meanwhile brought to ebullition, double decomposition takes place, sul-

phate of baryta is formed, and carbonate of soda is found in the solution; this solution is filtered, and is employed, by means of a similar reaction, for the production of carbonate of lead. This is effected by the addition of sulphate of lead to this fluid, through which, while it is brought to ebullition, a current of carbonic acid is passed; in this manner, sulphate of soda is again formed, and carbonate of lead is deposited. It should, however, be understood that these reactions do not yield—(1) as regards carbonate of soda, that salt at a less cost than the process by which it is usually made; (2) that the carbonate of lead is neutral carbonate, and is not, therefore, possessed of the requisite covering quality of white lead, $3(PbO,CO_2),PbO,HO$, which is a basic carbonate of lead, which cannot even be made by passing into an aqueous solution of sub-acetate of lead, carbonic acid gas; unless, as is done by M. Ozouf, at St. Denis, near Paris, the quantity of the gas is exactly regulated so as to produce a given quantity of white lead. The two following formulæ exhibit the reactions above alluded to:—

$$BaO,CO_2 + NaO,SO_3 = BaO,SO_3 + NaO,CO_2.$$
$$PbO,SO_3 + NaO,CO_2 = PbO,CO_2 + NaO,SO_3.$$

Quantitative Analysis of Raw Soda (Soda Ash) and Caustic Soda.—M. Jean.—After referring to the volumetrical methods devised by the late M. Gay-Lussac, and pointing out some inconveniences of this method, the author states that he proceeds as follows:—Take 4 grms. of the sample to be analysed, and dry completely at from 110° to 120°; the difference between the weight of the quantity originally taken and the weight after drying gives the quantity of water. Take 1 grm. of this dried material, place it in a glass tube, and pass a current of *dry* carbonic acid gas over the substance for about an hour; dry it again at 110°, to drive off any mechanically-adhering carbonic acid; place the substance upon a filter, and exhaust with tepid water (32°), until the wash water is no longer precipitated by chloride of barium. The filtrate is collected in a glass balloon with flat bottom, and chloride of barium is added to it. The liquid is left to settle, and, on having become quite clear, is drawn off from the precipitate, by means of a pipette, and the precipitate of carbonate of baryta is collected on a tared filter, washed with boiling water, dried, and weighed. If there happen to be sulphates present, the sulphuric acid is precipitated, along with the carbonate of baryta, as sulphate of that base, and the weighed carbonate of baryta is, therefore, washed with water acidulated with hydrochloric acid, again washed with warm water, and, after drying, weighed. In order to estimate the carbonate of soda, 1 grm. of the dried sample is taken, dissolved in water, precipitated with chloride of barium, the precipitate is collected on a tared filter, and, after having been washed and dried, there is deducted, from the weight found, the weight of the sulphate of baryta. The difference of the weights of the carbonates of baryta found by these two operations indicates the quantity of carbonate of baryta which, by calculation, has to be converted into caustic soda; the second assay gives the quantity of carbonate of soda. In order to estimate the sulphide of sodium contained, 1 grm. of the dried material is again taken; this quantity is dissolved in water, and estimated according to M. Gay-Lussac's method. Let us suppose that this assay has given a quantity of carbonate of soda equal to A, and that our previous operations gave us B of caustic soda and C of carbonate of soda; calculate the quantity of caustic soda, B, into C', as carbonate of soda—$C' + C = C'''$, total quantity of carbonate of soda indicated by the gravimetrical assay. The difference between the quantity, A, of carbonate of soda indicated by the volumetrical method, and C''', that found by the gravimetrical method, indicates the quantity of carbonate of soda which has to be calculated as sulphuret of sodium.

Preparation of the Sulphuret of Sodium by a New Process.—M. Jean.—After referring to the difficulties attending upon the preparation of sulphuret of sodium, by igniting a mixture of sulphate of soda and carbonaceous matter, whereby a pure product can never be obtained, the author states that he has found the following process to yield very satisfactory results:—25 kilos. of dry sulphate of soda, 75 kilos. of sulphate of baryta, 10 kilos. of powdered charcoal, and 15 kilos. of powdered pit-coal, are intimately mixed and ignited in an ordinary soda furnace. From time to time, a small sample of the ignited mass is taken, and tested by being dissolved in water, filtered, and to the filtrate a drop of a solution of sulphate of soda is added. As soon as a precipitate of sulphate of baryta ensues, the operation is finished, and the ignited mass is at once transferred to iron vessels, which can be closed with a lid, so that access of air is excluded while the mass cools down; after cooling, the crude sulphuret is placed in wrought-iron tanks, and boiling water is added and ebullition kept up for some time; some sulphate of soda is added, in order to precipitate excess of sulphide of barium. After the liquid has become clear, it is drawn off by means of a syphon, and the solution evaporated to dryness. The sulphuret of sodium obtained by this process is quite free from any undecomposed sulphate, from sulphuret of iron, from silica, and from alumina. By this process, the fire-bricks of the furnace are not acted upon, and the ignited mass is in pulverulent, and not in fused state, and therefore no grinding is required. When, instead of sulphate of soda, sulphate of potassa is used, an excellent sulphide of potassium is obtained, which would be greatly in demand for the manufacture of ferrocyanide of potassium by Géli's process, and for the artificial preparation of water impregnated with alkaline sulphides to be used for bathing purposes.

Purifying Bromide of Potassium.—Dr. Baudrimont.—The bromide of potassium is first qualitatively tested for the presence or absence of iodide of potassium; if that salt happen to be present, it is removed in the following manner:—About 10 grms. of the impure bromide are dissolved in a sufficient quantity of distilled water; a solution of bromine in water is then added in excess, this solution being preferable to bromine itself, as being more readily managed. The liquid is then heated to boiling, and kept so until no more vapours of iodine are given off. The liquid is next evaporated to dryness, in order to eliminate the excess of bromine. In this way a bromide of potassium is obtained free from iodide, but which may yet contain chloride of potassium.

Annales de Chimie et de Physique, October, 1869.

This number contains the continuation of an essay—

New Researches on Thermo-Chemistry.—M. Berthelot.—This paper is divided into several sections, each bearing a separate title:—Decomposition of organic substances by heat; action of the electric spark upon marsh gas; union of nitrogen in free state with acetylen; direct synthesis of hydrocyanic acid; formation and decomposition of sulphide of carbon; chemical equilibrium between carbon, hydrogen, and oxygen; the spectra exhibited by some compound substances when exposed to gaseous mixtures in state of equilibrium; influence of pressure upon chemical equilibria, and especially on the reactions taking place between carbon and hydrogen.

Memoir upon the Determination of the Lengths of the Waves of the Metallic Spectrum Rays.—M. R. Thalén.

Second Memoir on Supersaturation.—M. Lecoq de Boisbaudran.—This paper is the first instalment of a second memoir of the subject named at the head. The author says—"I intend to divide this essay into two sections; in the first of these, I shall record the action of some isomorphous substances upon the supersaturated solutions of the sulphates of the oxides of iron, nickel, copper, cobalt, magnesia, and zinc; in the second portion of this essay will be found described the action of the same isomorphous substances upon supersaturated solutions of two of the above-named sulphates at the same time.

Revue Hebdomadaire de Chimie, October 7, 1869.

This number contains:—

Description of an Air-Pump with Free Plunger.—M. Deleuil.—There is added to this paper a well-executed woodcut. It appears that the vacuum which can be maintained by this air-pump is more perfect than has hitherto been obtained by any ordinary pump of the sort. From recipients of 250 litres capacity, the air can be withdrawn so as to leave only 10 m.m. pressure in a quarter of an hour. There is, with this machine, no need for the use of any oil to counteract friction. The piston (plunger) is double-acting, and it moves as easily at the beginning of the operation of pumping as at the end, with a very rarefied air. The free space between the plunger and the body of the pump is only 1-50th of a m.m.

October 14, 1869.

This number contains:—

Use of Electric Alarums to Indicate a Certain Temperature. MM. Besson and Knieder.—The authors have constructed a set of thermometers, through the tubes of which are soldered two small pieces of platinum wire, which are not in metallic contact, until the mercury just rises to the height at which the wires have been placed. Since the latter are in contact with conducting wires to a suitable galvanic apparatus, the instant the mercury makes metallic contact, an alarum is sounded; and this may, of course, by proper adjustment, be affected at any temperature, which, for some purpose or other, should not be exceeded. The instrument is intended for industrial use.

Glycerine Soap.—M. Heeren.—Take 100 parts of oleine of commerce, pour it either in a glass flask (when only a small quantity of soap is intended to be made, or in a cauldron for large quantities), add 314 parts of glycerine of 1·12 specific gravity, heat to 50°, and then add 56 parts of an aqueous solution of caustic potassa (sp. gr., 1·34), and stir the mixture well. The soap is readily and rapidly formed; but the liquid has to be kept at rest for twenty-four hours, and then exhibits a mass of the consistency of honey, in which state it remains. Filtration may be required, but is troublesome and slow.

Test for Albumen.—Dr. Méhu.—Take of crystallised carbolic acid, one part by weight; of commercial acetic acid, the same quantity; of alcohol at 90 per cent, two parts; mix, and keep in a bottle. This fluid is intended to detect albumen in urine; and for that purpose, to 100 grms. of this liquid (urine) are added 2 c.c. of commercial nitric acid, and next, after thorough mixing, 10 c.c. of the carbolic acid solution. The reaction is stated to be very superior to the use of nitric acid alone.

Cosmos, October 16, 1869.

Liqueur de la Grande Chartreuse.—Dr. Chevalier.—According to this author, this celebrated liqueur, made at the Abbey of the name, near Grenoble, is composed of:—Essence of *melissa citrata*, 2 grms.; essence of hyssop, 2 grms.; essence of angelica root, 10 grms.; essence of best mint, 20 grms.; essence of nutmeg, 2 grms.; essence of cloves, 2 grms.; and 2 litres of rectified spirits of wine, of best quality. The liquid is artificially coloured, either with turmeric or any other suitable material.

Les Mondes, October 14, 1869.

Biography of A. von Humboldt.—M. C. Bruhns.—The Director of the Royal Observatory at Berlin has stated that he intends to publish a scientific biography of von Humboldt, with the co-operation of a great

number of German *savants*. The first portion of this work is entrusted to M. Lallemand, who has in his possession a large number of documents and manuscripts, never before published, relating to the late *savant's* life. The second portion of this work will consist of eight separate chapters, each treating of a peculiar science; and each chapter will be edited by the most eminent men in the department of science it treats of.

Removing Stains caused by Photographic Chemicals from the Hands.—M. Fortin.—Referring to the use of cyanide of potassium, and of iodide of potassium, and iodine for this purpose, the author says the first endangers health, and even imperils life; the second is very expensive. The author recommends, instead, to wash the hands with a concentrated solution of either sulphate or chloride of zinc, to which some acid is added at the same time. The deepest and blackest stains should be touched with metallic zinc, whereby the reduction of the oxide of silver or that of the gallate of iron is promoted, and all metallic stains adhering to, or penetrating in the skin removed. Since most of the salts of zinc are colourless, and soluble in water, the hands become soon quite clean. They should then be washed, first with pure water, and next with soap and water.

Preparation of Caustic Baryta for Industrial Purposes.—M. Nicklès.—Four operations are required—(1) Conversion of native sulphate of baryta into sulphide of barium is effected in a continuous manner, in a peculiarly-constructed furnace, the sulphate being previously mixed with a reducing substance; (2) the conversion of the sulphide of barium into hydrate of baryta by means of hydrated oxide of zinc; (3) dehydration of the hydrate of baryta by ignition along with saw-dust; (4) regeneration of the substance which has served for the desulphuration of the sulphide, and obtaining of sulphur.

Cultivation of Cotton in Southern France.—M. Croze-Mugnan.—The author states that, after having made a series of experiments for several years, he is convinced that the cultivation of the *Gossypium herbaceum* will be attended with excellent success in the warmer districts of the south of France.

New Theory of Gravitation.—M. Leray.—We only give the title of this paper, which is well worthy the notice of natural philosophers.

We learn from this paper that the Physical Society at Rotterdam, known as the Bataafsch Genootschap voor Natuur Schei en Werktiugkunde, has caused a number of medals to be struck to commemorate the hundredth anniversary of its existence. This medal, which is stated to be excellently well-made, bears upon the obverse the inscription, "Certos feret Experientia Fructus;" upon the reverse, "Societas Philosophiæ Experimentalis Batava Roterodami Centesimum Natalem Celebrans. In Memoriam Stephani Hoogendijk, Fundatoris, MDCCLXIX—MDCCCLXIX." This Society has a large and very valuable collection of physical instruments, a fine library, and holds its meetings and lectures in the very extensive second-floor halls of the Royal Exchange at Rotterdam.

October 21, 1869.

New Process for Concentrating and Utilising the Sun's Rays.—M. Delaurier.—The author proposes, for this purpose, a truncated cone, open at both ends, and lined inside with polished silver, the sun's rays being admitted by the largest opening. Since the angle of reflection is equal to the angle of incidence, all direct, or reflected rays, will be united at the narrower end of the cone. It is clear that, the greater the length of the cone, the less the opening of its top need be, and the greater will be the concentration of heat. The author's paper, to which a woodcut is added, enters into a discussion on the advantage of this contrivance above the use of lenses and mirrors; and the author very enthusiastically surmises that the heat of the sun's rays may be so concentrated as to serve, instead of the combustion of fuel, for various purposes, especially in countries where, as in Algeria, the heat and splendour of the sun is more permanently felt.

Ancient and Modern Industry of the Chinese Empire.—Among the *accusés de reception*, we find, under the above heading, "d'Après des Notices Traduites," par M. Stanislas Julien, et accompagnées de notices industrielles et scientifiques, par M. Paul Champion, Préparateur de Chimie au Conservatoire des Arts et Métiers, Ancien Délégué de la Société d'Acclimatation en Chine et au Japon; 1 vol., large octavo, 254 pages, and 13 lithographic plates. This is an authentic work, having been faithfully translated from the Chinese language by the best scholars versed in that language in France, while M. Champion has been residing a long time in China, and describes what he has actually seen. The work embraces the following subjects:—Fuel, salt, lime, sulphur, talc (magnesia minerals), nitrate of potassa (saltpetre), gunpowder, soda and potash, mineral pigments, alum, metals, vegetable colours and dye materials, vegetable wax (from trees), varnishes, oils, candles, ink, paper, printing, vegetable textile fibres, washing of garments, tobacco, papaver and opium, sugar, glucose, preservation of eggs, alimentary *regime* and wages, matches, amber, camphor, rearing of fish, magic lantern, boring of wells, silk, and some minor subjects. The entire work is full of extremely useful information, even for civilised Europe.

NOTES AND QUERIES.

Tungstate of Soda, &c.—Can any of your readers give us the names of manufacturers of tungstate of soda and tungstate of chrome?—J. C.

Bichromate of Potash.—Can any of your numerous readers inform me if bichromate of potash is manufactured anywhere else except in Scotland?—BICHROME, Glasgow, October 27, 1869.

Detection of Prussian Blue in Black Ink.—Can any of your readers kindly inform me how to detect Prussian blue in black ink, that is, if any has been used to give it a blue colour; and also if there is a means of telling when there is logwood used in the preparation, or galls.—J. KAYE.

Footpaths.—I wish to lay down a cheap footpath. Can any of your readers inform me of a compound that will harden and not be affected by the weather? I was thinking of using a mixture of tar pitch, sand, and gravel. What can I add to prevent it softening with the heat of the sun, if there is nothing cheaper, will cement do it? and if so what proportion must be used? Many of the streets in Paris are made with a compound put down in the form of powder, which after having been rolled with heavy rollers, becomes very hard, and forms a smooth and durable road. What is the mixture used?—ROADWAY.

Purification of Glycerine.—M. Kunath.—The glycerine used largely in those parts of Central Europe where the winters are severe for the filling of wet gas-meters has to be purified again, and concentrated after it has been in use for some time. For this purpose, the impure glycerine is poured in a large vessel, and, upon every hundredweight of glycerine, 10 lbs. of iron-turnings are added; the whole mass is thoroughly stirred up, and this stirring repeated for some hours every day for a fortnight. After that period, the mixture is left quietly standing for some weeks, when the clear liquid is withdrawn from the sediment by means of a syphon, concentrated by evaporation, and again used in the gas-meters. The iron-turnings act mechanically as well as chemically: sulphuret of iron is formed, and the formation of this substance aids the precipitation of tarry matters.—*Dresdener Gewerbe Vereins Zeitung*.

Rendering and Bleaching Tallow.—Will any of your practical correspondents kindly give me the best and cheapest methods of rendering and bleaching tallow from rough fat, and how much per cent of tallow should be realised from rough fat rendered by the aid of sulphuric acid (say about 1 per cent of acid); or is that quantity of acid too much, as I find a great variation in the quantity obtained from present results; the quantity of rough fat rendered at each operation is about 3 tons. Is bleaching with black oxide of manganese and sulphuric acid considered the best, or a good method? as I find, in practice, it gives a yellow tinge—occasionally. What may be the cause? as I cannot get the tallow as white as it ought to be; it is more like beef tallow, although it is rendered from a mixture of beef and mutton fat. What substance can be used to precipitate impurities arising from rendering and bleaching when the process of washing is going on? Also, is there any method that can be used to prevent tallow *seeding* (a term generally used in the trade, which denotes the separation of the oily portion from the solid parts), besides continual agitation, until sufficiently cold to be packed?—A TALLOW MELTER.

MEETINGS FOR THE WEEK.

THURSDAY, November 4th.—Chemical Society, 8. Discussion on Dr. Williamson's Discourse "On the Atomic Theory."

TO CORRESPONDENTS.

ERRATUM.—Page 201, column 1, bottom line, insert, after 120 c.c., the word *aniline*.

Ferrum.—Please forward your address.

BOOKS RECEIVED.

Exercises in Practical Chemistry, by A. G. V. Harcourt, F.R.S., and H. G. Madan, F.C.S.

Chemistry: General, Medical, and Pharmaceutical, including the Chemistry of the British Pharmacopœia. By John Attfield, Ph.D. London: John Van Voorst.

A Pharmacopœia, including the Outlines of Materia Therapeutics, for the use of Practitioners and Students of Veterinary Medicine. By Richard Tuson, F.C.S., &c. London: John Churchill and Sons.

Just published, demy 8vo., price 6d.

On English and Foreign Alkalimetrical and Chlorimetrical Degrees, by John Pattinson, F.C.S. Read before the Newcastle Chemical Society.

London: CHEMICAL NEWS Office, Boy Court, Ludgate Hill, E.C.

Professor Tennant, F.G.S., will deliver a Course of Lectures on MINERALOGY applied to GEOLOGY and the ARTS, at King's College, London, on Wednesday and Friday mornings, at nine o'clock, during October, November, and December, commencing October 8th. Fee, £2 2s.

A Course of Lectures on MINERALOGY and GEOLOGY will also be delivered, on Thursday evenings, at eight o'clock. These begin October 14th, and will be continued to Easter, 1870. Fee, £1 11s. 6d. Professor Tennant gives PRIVATE INSTRUCTION in Mineralogy and Geology, Illustrated by a large number of Specimens, at his Residence, 149, Strand, W.C.

THE CHEMICAL NEWS.

VOL. XX. No. 519.

ON THE

METHODS OF ANALYSIS AND THE COMPOSITION OF VARIOUS CHEMICAL MANUFACTURING PRODUCTS.

By M. GASTON TISSANDIER.

(Continued from p. 95.)

SULPHATES OF POTASH.

ALMOST all commercial sulphates of potash are obtained from beet-root salts, or by treating the ashes of seaweed. All specimens, whatever their origin, may, however, be analysed in the following manner.

Mode of Analysis.—Weigh 25 grms. of the sulphate in question, and dissolve in distilled water; filter, to separate the insoluble substances, and wash the filter until the clear liquid, collected in a graduated measure, occupies the volume of 500 c.c.

Alkalimetric or Acidimetric Standard.—Plunge sensitive litmus paper into the solution, and ascertain whether it be alkaline or acid. In the first case, take the alkalimetric standard in 100 c.c. In the second, which is less frequent, obtain the acidimetric standard by means of a standard potash solution.

Sulphuric Acid.—The sulphuric acid is estimated in 10 c.c. of the solution (0·5 grm.), by means of chloride of barium.

Chlorine.—Determine the proportion of chlorine in 50 c.c. (2·5 grms.) by standard nitrate of silver.

Potassium.—To estimate this exactly, add to 10 c.c. of the solution a few drops of chlorhydric acid and of a standard solution of chloride of strontium, in such quantity that all the contained sulphuric acid may be precipitated in the state of sulphate of strontia. Let it stand for twelve hours; filter, and, after washing the precipitate, evaporate the filtered liquid almost to dryness. Add a slight excess of bichloride of platinum, and evaporate with the precipitated chloroplatinate of potash, which must be collected and weighed, as directed under the article "Salts."* The transformation of the sulphate into chloride by the chloride of strontium is indispensable, if an exact result be desired. Were the bichloride of platinum added directly to the solution of the sulphate, the potash would not be entirely precipitated; the precipitated chloroplatinate would contain, as has been already proved, a certain proportion of non-decomposed sulphate.

Moisture.—The salt is dried on a stove, at 110°, or in a platinum crucible.

Calculation of the Analysis.—The potassium found is converted into sulphate of potash, and it is seen by calculation if the quantity of sulphate of potash so formed contains the proportion of sulphuric acid found. If there is an excess of sulphuric acid, it is converted into sulphate of soda. If, on the other hand, the quantity of potassium is too considerable to saturate the whole of the sulphuric acid, the excess must be combined with chlorine and carbonic acid, Some sulphates contain chlorhydric acid. Its presence may be accounted for by the addition of sulphuric acid in the manufacture. The sulphuric acid is used to transform the carbonate of potash into sulphate, but, if added in too great excess, it will act upon the chloride of potassium, and give rise to an equivalent quantity of chlorhydric acid.

* CHEMICAL NEWS, vol. xx., p. 73.

COMPOSITION OF COMMERCIAL SULPHATES.

I. *Sulphates obtained from Beet-root Salts.*

Matters estimated.	I.	II.	III.	IV.	V.
Moisture	5·61	4·47	1·99	1·61	3·11
Insoluble matter	0·22	0·41	1·18	0·42	0·16
Chloride of potassium	2·77	1·72	1·61	1·68	1·20
Sulphate of potash ..	85·80	91·08	92·50	93·79	91·20
Carbonate of potash ..	3·00	2·60	2·72	2·41	4·11
Carbonate of soda ..	2·60	—	—	—	—
Non-estimated and loss	—	0·20	—	0·09	0·22
Total	100·00	100·00	100·00	100·00	100·00
			M. A. Lefebvre, Corbehem, near Douai.		M. Dronlers, Aseq, nr. Lille.

II. *Sulphates obtained in the Manufacture of Iodine.*

Matters estimated.	I.	II.	III.	IV.	V.
Moisture	3·99	2·02	1·22	4·21	1·01
Insoluble matter	0·29	0·20	0·10	0·19	0·12
Chloride of sodium ..	7·12	8·72	1·32	1·66	5·80
Sulphate of potash ..	75·84	75·12	75·62	77·00	82·69
Sulphate of soda.. ..	11·45	12·81	21·12	16·22	9·35
Carbonate of soda ..	0·80	0·71	0·62	0·72	1·03
Non-estimated and loss	0·51	0·42	—	—	—
Total	100·00	100·00	100·00	100·00	100·00

CAUSTIC SODA.

Specimens of commercial caustic soda generally present the appearance of greenish or yellowish masses, which must be quickly crushed into small fragments before analysis. For this purpose, it is best to employ a cast-iron mortar, perfectly clean, and previously warmed, in order that the soda may not absorb atmospheric moisture in any appreciable quantity during the crushing. Commercial caustic sodas always contain chloride of sodium, sulphate and carbonate of soda. The method by which the exact proportion of these constituent elements may be ascertained will now be shown.

Total Alkalimetric Standard.—Weigh 5 grms. of caustic soda quickly, and dissolve them in water. Take the alkalimetric standard in the cold, by means of ordinary standard sulphuric acid. The total standard of caustic soda is sometimes from 108° to 110°.

Estimation of Caustic Soda.—Weigh 5 grms. of caustic soda, and throw them into a stoppered flask containing about 400 c.c. of water: distilled water, previously boiled, to avoid its containing carbonic acid, is the best. When the soda has been dissolved by stirring, add an excess of chloride of barium, which will precipitate the sulphate of soda as sulphate of baryta, and the carbonate of soda as carbonate of baryta. The liquid thus formed must be filtered, care being taken to close the flask as much as possible, and to cover the top of the filtering funnel with a plate of glass, to avoid the action of the air. It is especially needful to place the funnel in a flat-bottomed flask, that the filtered liquid may not come in contact with the ambient air. Litmus is added to the filtered liquid, and the alkalimetric standard taken in the cold. The addition of normal sulphuric acid solution causes the formation of a precipitate of sulphate of baryta, due to the excess of chloride of barium; but this occurrence is of no importance. The number of divisions on the burette must be read at the exact moment when the last drop of standard liquid causes the solution to change from violet-blue to vinous-red. This number gives the standard of causticity, which, again, shows, by calculation, the quantity of caustic soda according to the following equation:—

$$\frac{\text{Standard or number of divisions on the burette}}{x} = \frac{49(SO_3,HO)}{40(NaO,HO)}$$

The standard of causticity obtained, deducted from the total standard, gives the standard corresponding to the carbonate of soda, and, consequently, the proportion of

the latter salt. To be more exact, this determination should be verified in the following manner.

Carbonate of Soda.—The filter containing the sulphate and carbonate of baryta will also serve to determine the quantity of carbonate of soda. Pour upon the filter water acidulated with pure chlorhydric acid, which will dissolve only the carbonate of baryta, without acting at all upon the sulphate. The filtered liquid contains, in the state of chloride of barium, all the baryta of the carbonate of baryta. Sulphuric acid is now added, and, after standing for twelve hours, the precipitated sulphate of baryta is weighed. This sulphate of baryta is transformed, by calculation, into carbonate of baryta; or, directly, by equivalents, into carbonate of soda; and thus the quantity of the latter salt contained in 5 grms. of caustic soda is ascertained.

Sulphate of Soda.—The amount of sulphuric acid in caustic soda is estimated in 5 grms. of the specimen under analysis, by means of chloride of barium (see article, "Salts" *ante*). If it be desired to omit this experiment, the filter used to obtain the standard of causticity may be immediately weighed, after rinsing with chlorhydric acid, to remove the carbonate of baryta. In this case, in order that the estimation may be exact, the precipitate of carbonate and sulphate of baryta must be allowed to stand for twelve hours.

Chloride of Sodium.—Weigh 2·5 grms. of caustic soda, and throw into a stoppered flask; dissolve it in water, acidulate with pure nitric acid, and estimate the chlorine with the standard nitrate of silver liquid (see article, "Salts," *ante*).

Moisture.—The moisture contained in caustic soda is estimated by operating in a silver crucible, which must have a cover. It is weighed empty, and again weighed with a small quantity of caustic soda. Heat is carefully applied to fuse the soda: great precaution must be used that the temperature may not be too much increased, in order to avoid projections. The action of too much heat would not only remove the moisture, but also part of the water in combination with the caustic soda, and the erroneous figure thus obtained would be, in that case, much too high. The caustic soda, once fused, is again weighed, and the three weights thus obtained are the bases of a simple calculation, which will give the quantity of humidity contained.

Calculation of the Analysis—Some of our readers have asked for more ample details respecting the calculations necessitated by these modes of analysis. We will, therefore, re-produce an example of the analysis of caustic soda.

Direct Results of an Analysis of Caustic Soda.

Total standard, 109°.

Standard of causticity, 106°.

Number of divisions of the graduated burette of nitrate of silver (estimation made on 2·5 grms.), 101 divisions.

Weight of the sulphate of baryta in 5 grms., 0·195 grm.

By deducting the standard of causticity from the total standard, the standard of carbonate of soda is obtained. Say, 109 − 106 = 3. To obtain the quantity of carbonate of soda corresponding to a standard of 3 degrees, it is only necessary to state the following equation:—

$$\frac{3}{x} = \frac{49(SO_3HO)}{53(CO_2NaO)}$$

Whence x (carbonate of soda) = 3·44 per cent.

The standard corresponding to the caustic soda is 106°. Consequently,

$$\frac{106}{x} = \frac{49(SO_3,HO)}{40(NaO,HO)}$$

will give x (hydrated caustic soda) = 86·53 per cent.

Commercial caustic soda is generally sold according to the quantity of anhydrous soda, NaO. To obtain NaO, state the equation—

$$\frac{86{\cdot}53}{x} = \frac{40(NaO,HO)}{31(NaO)}$$

Whence x (NaO) = 67·306 per cent,

For the chloride of sodium, the standard liquid containing nitrate of silver in such a quantity that one division corresponds to 1 milligramme of chlorine, state the equation—

$$\frac{101}{x} = \frac{35{\cdot}5(Cl)}{58{\cdot}5(NaCl)}$$

Whence x = 1·66. But 2·5 grms. were operated upon; it is, therefore, necessary to multiply by 40 to obtain the quantity of chloride of sodium in hundredths.

1·66 × 40 = 6·64, or ClNa = 6·64 per 100.

The sulphate of baryta, in 5 grms., weighs 0·195 grms. Consequently, the equation—

$$\frac{0{\cdot}195}{x} = \frac{116{\cdot}5(SO_3BaO)}{71(SO_3,NaO)}$$

will give x = 0·118 × 20 = 2·36 of SO_3NaO per cent.

The analysis is thus formularised, after estimating the moisture, which we will suppose to exist in the specimen under analysis in the proportion of 1·02 per cent.

Moisture	1·02
Chloride of sodium	6·64
Sulphate of soda	2·37
Hydrated caustic soda	86·53
Carbonate of soda	3·44
	100·00

Oxide of sodium (NaO) = 67·306 per cent. We have omitted the calculation relative to the determination of the carbonate of soda by the carbonate of baryta, as it is sometimes unnecessary. Supposing the above analysis to have been scrupulously exact, the carbonate of baryta dissolved in pure chlorhydric acid, and precipitated as sulphate of baryta, would yield a weight of 0·379 of sulphate of baryta.

$$\frac{0{\cdot}379}{x} = \frac{116{\cdot}5(SO_3BaO)}{53(CO_2NaO)}$$

would give x = 0·172 as the quantity of carbonate of soda contained in 5 grms. Multiplying by 20, the product would be—Carbonate of soda = 3·44 per 100.

Composition of Caustic Sodas.

Matter estimated.	I.	II.	III.	IV.	V.	VI.
Moisture	4·38	3·31	3·71	0·59	0·68	1·11
Chloride of sodium	11·32	12·22	3·90	7·23	6·89	5·60
Sulphate of soda	3·41	2·00	2·60	1·00	1·32	2·10
Carbonate of soda	5·58	9·82	3·69	3·45	3·68	5·48
Caustic soda (NaO,HO) ..	75·21	72·65	86·10	87·73	87·50	85·71
Total	100·00	100·00	100·00	100·00	100·00	100·00
Oxide of sodium (NaO) p. 100	58·10	56·30	66·67	68·00	67·80	66·42
	French sodas.			English sodas.		

Sodas of a much poorer quality than those whose composition we have just given are occasionally to be met with. We subjoin an example of the analysis of one of these poorer caustic sodas. Caustic sodas are generally sold according to the quantity of anhydrous oxide of sodium (NaO); and the analyses are usually formularised in the above manner. It will be seen from the above figures that the products of English manufacture are much richer than the French. Some few French manufacturers have already brought the production of caustic soda to perfection; but much progress still remains to be realised in France with respect to this manufacture.

Composition of Very Poor Caustic Soda.

Matter estimated.	I.	II.	III.
Moisture	1·01	0·92	0·99
Chloride of sodium	18·86	19·76	17·47
Sulphate of soda	7·42	3·09	2·36
Carbonate of soda	6·48	34·63	38·37
Hydrated caustic soda	66·12	41·60	40·81
Total	100·00	100·00	100·00
Oxide of sodium (NaO) per 100 ..	51·24	32·24	31·69

(To be continued).

ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 209.)

THE microscopist, in the course of his studies, will find a very large class of substances for which the processes described in the preceding chapter are of no avail, owing to the impossibility of drying them without materially affecting their structure. The preservation of such substances has always been a matter of some trouble; and beginners are frequently deterred from attempting the processes of fluid mounting by supposing that the difficulties are of an insurmountable kind.

There is also a prejudice against objects mounted in fluid, owing to their supposed want of durability. There is, no doubt, some ground for this objection if the ordinary fluid-mounted objects only are considered. These are of necessity manufactured cheaply and in large numbers, and but little care can be bestowed upon their preparation. But, if the cabinets of our best manipulators are examined, the evidence will be found rather in favour of than against fluid mounting, provided care be taken to adopt the best processes, and carry them out carefully; the causes of failure being rather attributable to bad workmanship than to defects in the mode of preparation. Instances are on record of objects mounted in fluid as long ago as twenty years being still in good preservation.

The subject naturally divides itself into two parts; the processes connected with the enclosing of the object in its cell, and the consideration of the nature of the fluid media employed as preservatives.

The object to be mounted in fluid will nearly always require some previous preparation, excepting in those cases where it is free from included air, and the fluids contained in its tissues are readily miscible with the preservative employed. This preparation consists in keeping the tissues required for preservation immersed either in the fluid in which they are to be mounted, or some other which is capable of combining with it without injurious chemical change. This soaking will occasionally occupy a considerable time; but it may be materially expedited by making use of the air-pump, which will ensure the saturation of the tissue, and assist in the removal of air that may be held within it. The process is exactly the same as that adopted on the large scale for the preservation of railway-sleepers, by impregnating them with creosote; and, in another operation (one that more closely approaches the subject under consideration), Manfield's patent for making pickles, in which the vegetables to be treated are saturated in a few minutes with vinegar, by being submitted to its action in a vessel from which the air has been exhausted; a process which took so long a time in the ordinary way, that manufacturers, to save the loss of capital involved in using vinegar, employed brine, which was afterwards removed by strong acetic acid, greatly to the detriment of the resulting manufacture, both as to flavour and wholesomeness. This is now obviated by the new process, the pickles produced by which closely resemble those made at home.

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

Although the air-pump is useful where substances peculiarly liable to retain air (such as large anatomical preparations) are being operated upon, its use can generally be dispensed with for ordinary purposes, a prolonged soaking being sufficient in most cases.

In mounting an object in fluid, a cell of suitable size and depth is to be selected, and care taken that it is properly cleaned. It is then filled with the mounting fluid, and should be rather over than under filled. The object is now placed in the cell, unless circumstances have rendered it advisable that this should be done previously. The preparation, at this stage, should be carefully examined, with a view to the detection of air-bubbles. They are especially liable to adhere to the lower part of the cell, where it joins the glass slide. They are best dislodged by drawing the point of a needle round the interior of the cell. Floating bubbles may be broken or removed by lightly touching with a pointed fragment of blotting-paper.

The cover glass is to be placed upon the cell as directed in balsam mounting—letting one edge touch the cell first; and, as in that process care was taken to keep everything dry, in fluid mounting we should adopt the opposite course of treatment. To secure the adhesion of the mounting fluid to the cover, and lessen the chance of including an air-bubble, it is well to moisten the cover by breathing on it just before placing it on the cell.

The surplus fluid is best removed, in the first instance, by drawing it off with a curved and sharp-pointed pipette, made in the form of an ordinary blow-pipe. The use of this contrivance will generally allow the floating cover to be brought in contact with the top of the cell without the risk of flooding its upper surface, which is nearly sure to take place when the cover is pressed down suddenly, and will give trouble to remove when viscid fluids like glycerine and oil are used. When as much of the fluid is removed as can be conveniently taken up with the pipette, the rest is absorbed by the careful use of fragments of blotting-paper. Care must be taken not to carry this process too far, as, if too much of the fluid is absorbed, an air-bubble may enter, which will necessitate the removal of the cover and a repetition of the operation. The moisture being cleaned off the outside, the cell is ready to receive its first coat of varnish, which is to be applied with a small brush, and care should be taken to fill the angle at the contact of the cover and cell, and to include in the ring of varnish a small portion of the edge of the cover. This first coat of varnish must be put on by hand, as the adhesion of the cover is too slight to bear the action of the turn-table, which machine, however, may be employed with advantage in laying on the second and subsequent coats, as, by its use, greater neatness and rapidity are attained than are possible by painting on the varnish by hand.

The best and most durable cement for securing the covers of objects mounted in fluid is the varnish known as japan gold-size, the principal constituent of which is boiled linseed-oil. It is easily obtained at any varnish shop. It is best kept for use in the collapsible tubes recommended for holding Canada balsam. If kept in a bottle, it absorbs air, thickens, and loses, to some extent, its drying properties. This varnish is remarkable for its elasticity and toughness when dry, which may readily be proved by scraping a portion, which will be found to come

away in shreds instead of chipping, as many other varnishes do. Glycerine and castor-oil, both valuable mounting fluids, have the unfortunate property of dissolving gold-size; therefore, in using these media, it is necessary, before putting on the coatings of gold-size, to apply two or three coatings of the liquid glue previously mentioned. This varnish is impervious to oil and glycerine, but is too brittle when dry to be trusted alone. The liquid glue will be found effectually to protect the gold-size, with which the preparation is to be finished. This precaution is not required when using media which do not injuriously affect gold-size, such as weak alcohol and water, saline solutions, camphor and creosote water, &c.

Some microscopists make use of asphalte or Brunswick black for securing the cover. They have the fault of being brittle, which, however, is said by Dr. Beale to be remedied by the admixture of a small portion of solution of india-rubber in naphtha. The author's experience of this cement is rather unfavourable. It may, however, be owing to having used a bad specimen; as it is probable that many kinds of Brunswick black are manufactured, and they are likely to vary extremely in quality. However, as gold-size is so reliable a cement, and so easily procured, there is no occasion to risk the use of a varnish whose properties are somewhat uncertain.

Should the mounting fluid be one which leaves a deposit on drying (which is the case with saline solutions), or be difficult to clean off (like glycerine), after the first coat of varnish is dry, the slide should be washed, either by holding under a partially-open tap, or by means of the ordinary wash-bottle. If this precaution is not taken, the adhesion of the cement is rendered uncertain, and neglect of this matter is a not unfrequent cause of leakage. If necessary, this washing must be repeated after the second coat of varnish. With oil, a somewhat different treatment is needed. The cleaning is best effected with a camels'-hair brush, charged with turpentine or benzol.

The slide should not be put away in the cabinet until it has received at least six or eight coats of gold-size. No varnish should be laid on thickly, otherwise it is liable to remain fluid in the interior, although apparently hard outside.

In commencing the practice of fluid mounting, it will be advisable for the student to make his first trials with some such fluid as camphor-water or diluted alcohol, as the difficulties of cleaning, &c., are much less than with saline solutions or glycerine.

A very ingenious process of fluid mounting forms the subject of a communication by Mr. T. C. White to the Quekett Microscopical Club (*Journal of the Quekett Microscopical Club*, vol. i., p. 147). He forms a cell with a thick varnish, made by dissolving gum damar in benzol. This is done by holding a brush charged with it against a slide while revolving on the turn-table. The cell will be ready in a few minutes, as it is used while half dry. The fluid and object are placed in the cell, and the cover glass put on, and pressed down into the cement, which adheres most tenaciously to wet glass. The surplus fluid is to be removed with blotting-paper, which may be used with the greatest freedom, as the glass is held very firmly by the damar varnish, another coat of which is applied by means of the turn-table, and the slide is completed. It would no doubt be more secure if finished with a few coats of gold-size. This process can only be used by those who are somewhat expert, as, should the first attempt fail, the cover cannot be removed and the process repeated. It is a very expeditious mode of mounting, and is likely, in some cases, to prove of great value. Mr. White states that he has had slides mounted for two years which are still perfectly sound and free from air-bubbles. The solution of damar may also be used as a very efficient substitute for the mixture of balsam and benzol. It is, like most varnishes, rather troublesome to make, as, owing to the impurities usually contained in the gum, the varnish requires straining; a somewhat difficult matter with so volatile a solvent as benzol.

(To be continued.)

VOLUMETRIC SOLUTIONS FROM WHICH THE PERCENTAGES MAY BE READ OFF IN THE NUMBER OF VOLUMES REQUIRED.

By WATSON SMITH, F.C.S.

The great advantage to commercial analysts of a method of constructing volumetric solutions from which the percentages may be read off in the number of volumes of such solutions required, or ascertained by a very simple calculation which can be mentally performed with ease, is, I think, palpable. The following is an outline, with examples of the methods of calculation required in titrating these solutions:—

For the sake of brevity, let x = weight of body taken, in which it is required to find the percentage of l; let n = number of volumes of solution required, and *p.c.* stand for percentage.

1st. Solutions from which the *p.c.* may be read off directly, or *p.c.* = n.

The solution is so made that the weight of l, to which each 100 volumes is equivalent, = x; or, in other words, the solution is so made that 100 vols. thereof shall just be equivalent to the amount of l in the weight, x, of the body, supposing it to contain 100 *p.c.* of l.

From the foregoing, it will be seen that, for each solution, x must be a constant weight, in order that the percentages may be obtained in each special manner.

Now, by way of verification, let $x = 10$.

a. Then each volume of solution must be equivalent to 0·1 l or 100 vols. = 10 l.

And, say, 55 vols. of solution have been required in an experiment, then the body contains $\frac{55 \times 0{\cdot}1 \times 100}{10} = 55$ *p.c.* of l.

β. Let $x = 4{\cdot}4$. Each volume of solution must = 0·044 l (100 vols. = 4·4 l); and, say 55 vols. of solution have been required, the body contains $\frac{55 \times 0{\cdot}044 \times 100}{4{\cdot}4} = 55$ *p.c.* of l.

As practical examples, take the following:—

a. It is required that the *p.c.* of NH_3 in a sample of ammonium sulphate be ascertained. Let 5 grms. = x (see Chemical News, Notes and Queries, vol. xx., p. 168); then the acid solution (say hydrochloric) must be made so that each c.c. is equivalent to 0·05 grm. of NH_3 = 0·091 grm. Na_2O.

This is done by weighing out $\frac{106 \times 2{\cdot}5}{132} = 2{\cdot}008$ grms. of sodic carbonate (pure and freshly-ignited), and making the acid so that 50 c.c. thereof are just sufficient to neutralise this 2·008 grms.

A *sodic-carbonate* solution must now be made, exactly equivalent to the acid solution; *i.e.*, 100 c.c. must contain $\frac{5 \times 106}{132} = 4{\cdot}015$ grms. of Na_2CO_3, or 40·15 grms. per litre. Therefore, 40·15 grms. of pure freshly-ignited sodic-car-

bonate must be weighed out, dissolved in pure distilled water, and diluted to 1 litre.

Now, supposing the NH_3 has been distilled off, from the weight of sulphate taken, into 24 c.c. of the HCl solution, and 3·5 c.c. of sodic carbonate solution have been required to neutralise the excess of HCl, then 24 − 3·5, = 20·5 *p.c.* of NH_3 are contained in the sample of sulphate.

b. Again, a convenient "test acid" for estimating the *p.c.* of soda in samples of sodic carbonates and hydrates may be made as follows:—Dilute a quantity of sulphuric acid with about its own bulk of water, and let stand till cold; then further dilute till a Twaddell's hydrometer marks in it 10½° (which indicates about the sp. gr. of the required acid). 5 grms. of pure freshly-ignited sodic carbonate are now weighed out, and the acid is so adjusted that 58·5 c.c. are just required for neutralisation. (NB. Pure Na_2CO_3 contains 58·5 Na_2O.)

2nd. Solutions of decimal strength, or in which *p.c.* = $n \times 0{\cdot}1$.

Where the reagent from which the volumetric solution is to be made is expensive, and the percentages happen to be low, a more dilute liquor is used, and thus a smaller weight, to represent x, is to be taken. Thus, for example, a convenient silver solution, for the determination of the *p.c.* of NaCl in samples of salt-cake, may be made as follows:—

Let x = 2 grms. Make the nitrate of silver solution of such strength that each c.c. = 0·002 grm. of NaCl—*i.e.*, equivalent to 2 grms. of NaCl per litre of silver solution, or 0·2 grm. of NaCl per 100 c.c. Now 2 grms. of NaCl are equivalent to $\frac{2 \times 170}{58{\cdot}5} = 5{\cdot}81$ grms. of $AgNO_3$; therefore weigh out 5·81 grms. of $AgNO_3$, dissolve in pure distilled water, and dilute to 1 litre.

From the preceding, it is seen that the silver solution is so made that 100 vols. thereof shall be equivalent to the amount of $l \times 0{\cdot}1$ in the weight, x, taken (supposing x to contain 100 per cent of l); so that n vols. being required, *p.c.* = $n \times 0{\cdot}1$.

3rd. Solutions of half strength are, also, often useful where the *p.c.* of l is usually very large, and but a small quantity of the body can be conveniently taken (to represent x), for various reasons. In this case *p.c.* = $n \times 0{\cdot}5$.

For a solution of the above strength, 100 vols. of such solution must be equivalent to the amount, $l \times 0{\cdot}5$, in the weight, x, taken (supposing x to contain 100 *p.c.* of l); so that if x = 1 grm., and n = 30 c.c. $30 \times 0{\cdot}5$, or $\frac{30}{2}$ = 15 *p.c.* of l, are contained in the body experimented upon.

Of course, by varying the weight, x, in a particular manner, the same solution may be actually altered from decimal to half strength, or from half to full strength, &c.; thus, from decimal to half strength, take 1-5th x; from half strength to full strength, take ½ x; and from decimal to full strength, take 1-10th x.

The burette, which is used for titrating each solution, should be always used for that particular solution, as burettes which are graduated to hold equal volumes are very often found erroneous.

ECLIPSE OBSERVATIONS.

AMONG the various observations made at the last eclipse, none exceed in interest those of Professor C. A. Young, of Dartmouth College, Hanover, New Hampshire. We quote from the *Journal of the Franklin Institute* an abstract of this gentleman's report:—

The observer was a member of the party under the direction of Professor J. H. C. Coffin, of the Nautical Almanac Office, stationed at Burlington, Iowa.

The instrument employed was a spectroscope with 5 prisms of 45° each, having faces 2¼ by 3¼ inches; the collimator and telescope had apertures of 2¼ inches, with a focal length of 17. These were connected with a "comet seeker" of 4 in. aperture and 30 in. focus, used with an eye-piece, and giving an image of the sun, 2¼ inches in diameter, on the slit of the spectroscope. A graduated screen at the slit determined positions of points on the sun's limb, and a wire micrometer measured the positions of spectrum lines. The whole was mounted equatorially with slow motion screws.

Protuberances were noted before the eclipse at + 85° to 100°, large and not very bright; at + 146°, small and bright. The photographs show another at 155°, which escaped notice; also at − 70° to 80° low, but pretty bright; and at − 130°, very large and bright, the principal one. Angles are reckoned on the sun's limb from the North point, + towards the East, − towards the West.

The first contact was observed by watching the gradual shortening and final extinction of the bright line, C, in the spectrum of the prominence, which happened to be at the point of contact. The moon's approach was perceived full thirty seconds before its actual appulse; the observation was perfectly easy, and the time determined is certainly to be relied on within half a second, and probably much less. The presence of a prominence at the point of contact is not essential to the success of the method, as there is everywhere on the sun's limb sufficient depth of chromosphere to answer the purpose.

It is proposed to apply the spectroscope to observations both of the external and internal contacts at the next transit of Venus.

During the totality, the following nine bright lines were observed in the spectrum, viz., C dazzling in brilliance; 1017·5 (near D, the numbers refer to Kirchhoff's scale), very bright, but not equal to C; 1250±20, very faint, position only estimated; 1350±20, like the preceding; 1474 (a little below E) conspicuous, but not more than half as bright as 1017·5; F, next to C in brightness; 2602±2, a little fainter than 1474, position determined by micrometrical reference to the next; 2796, a little below G, the well-known H.γ line in brightness between 1017·5 and 1474; and finally H, or Hδ, somewhat brighter than 1474. B was not seen, it is supposed on account of a mistake in carrying that portion of the spectrum through the field while there was no prominence on the slit.

The line 1474 was recognised as belonging to the spectrum of corona, in the first place, by its extending clear across the spectrum, while 1017 did not, and then by its remaining visible when the slit was moved away from the protuberance, while the other lines (C and 1017) disappeared. The impression of the observer is that faint lines 1250 and 1350 behaved in the same manner; but his recollection as to this point is not very certain.

These three lines, 1250, 1350, and 1474, coincide far within the probable errors of observation with three lines observed by Professor Winlock in the spectrum of the Aurora Borealis. The two first are not accurately enough determined, in position, to allow much stress to be put upon any apparent coincidences on their part, but the last is perfectly well known, and its exact agreement throughout with one of the fainter lines of the Aurora, when combined with the general appearance of the Corona and other considerations, give a good deal of probability to the conjecture that our Aurora Borealis and the Solar Corona are identical phenomena.

* A careful examination of the photographs of the prominences on the eastern limb of the sun, upon which the slit of the spectroscope was directed during the first half of totality, somewhat diminishes my confidence in the conclusion of the text, as to the nature of these three lines. I think it absolutely certain that they do not belong to the spectrum of the brilliant portion of the prominences; but the photograph shows, in addition, an extensive nebulosity surrounding the nuclei with a pretty definite boundary of its own; this nebulosity is best seen in No. 2 of the totality pictures taken at Burlington. Now, it is possible that these lines may belong to this nebulosity, and not to the corona proper; for I cannot recall, with certainty, whether the 1474 line retained its brilliance at any considerable distance from the prominences. My impression is that it did, and that the text is correct, but do not wish to be too positive. The eclipse of December, 1870, will decide, of course.

The line 1474 is given by both Kirchhoff and Angström (not by Huggins, who, however, omits many faint lines), as belonging to the iron spectrum, and this suggests the inquiry whether we are to admit the existence of iron in the auroral heights of our atmosphere, or are to account for this line in the iron spectrum by some unknown substance of gaseous nature.

The corona showed, also, a faint continuous spectrum without any trace of dark lines. The light of this faint spectrum, tested by a tourmaline held in the hand next the eye, was strongly polarised in a plane passing through the sun's centre. As the direction of the spectroscope slit was nearly radial, it is not impossible that Professor Pickering may be right in explaining this polarisation as caused by the successive refractions through the prisms.

Professor Young's remarks, in his note on the lines in the corona or glow, are curiously in accordance with those of Dr. B. A. Gould, given in the same journal as an extract from a letter to its editor, Professor Henry Morton, who organised and conducted the largest and most successful photographic party during the late eclipse.

Photographs of the Chromosphere.

In a letter just received from Dr. B. A. Gould, we find the following interesting paragraphs, which, with his permission, we extract:—

"An examination of the beautiful photographs made at Burlington and Ottumwa, by the sections of your party in charge of Professors Mayer and Himes, and a comparison of them with my sketches of the corona, have led me to the conviction that the radiance around the moon, in the pictures made during totality, is not the corona at all, but is actually the image of what Lockyer has called the chromosphere.

"This interesting fact is indicated by many different considerations. The directions of maximum radiance do not coincide with those of the great beams of the corona; they remained constant while the latter were variable; there is a diameter, approximately corresponding to the solar axis, near the extremities of which the radiance upon the photographs is a minimum, whereas the coronal beams in these directions were especially marked during a great part of the total obscuration. The coronal beams stood in no apparent relation to the protuberances, whereas the aureole, seen upon the photographs, is most marked in their immediate vicinity. Indeed, the great protuberance, at 230° to 245°, seems to have formed a southern limit to the radiance on the western side, while a sharp northern limit is seen on all the photographs at about 350°, the intermediate arc being thickly studded with protuberances, which the moon displayed at the close of totality. The exquisite masses of flocculent light on the following limb are upon the two sides of that curious prominence at 93°, which at first resembled an ear of corn, as you have said, but which in the latter pictures, after it had been more occulted, and its southern branch thus rendered more conspicuous, was like a pair of antelope horns, to which some observers compared it. Whatever of this aureole is shown upon the photographs, was occulted or displayed by the lunar motion, precisely as the protuberances were. The variations in the form of the corona, on the other hand, did not seem to be dependent in any degree upon the moon's motion.

"The singular and elegant structural indications, in the special aggregations of light on the eastern side, may be of high value in guiding to a farther knowledge of the chromosphere. They are manifest in all the photographs by your parties which I have seen, but are especially marked in those of shortest exposure, such as the first one at Ottumwa. In some of the later views they may be detected on the other side of the sun, though less distinct. But the very irregular and jagged outline of the chromosphere, as described by Janssen and Lockyer, is exhibited in perfection.

"This happy result is clearly attributable to the relative shortness of the time of exposure by which the highly photographic rays of the chromosphere have depicted themselves, without obliteration by the mass of coronal light which veiled them from the eye. Let us hope that at the next total eclipse some impressions may be taken with an exposure not exceeding a single second, as you have suggested. The inference seems warrantable that in this way, better than in any other, the internal structure of the protuberances may be exhibited, though other phenomena may fail to record themselves.

"You will observe that some of the brighter, petal-like flocculi of light have produced apparent indentations in the moon's limb at their base, like those at the basis of the protuberances. These indentations are evidently due to specular reflection from the moon's surface, as I stated to the American Association at Salem last month. Had any doubt existed in my mind previously it would have been removed by an inspection of the photographs.

"I shall send the substance of these remarks to Professor Coffin, as a sort of postscript to my report, which contains only the results of personal observation at the time."

SIMPLE APPARATUS
FOR
RAPID VAPOURISATION AT LIMITED HEAT,
UNDER REDUCED PRESSURE, WITHOUT USE OF A PUMP.

By A. B. PRESCOTT,
Assistant Professor of Chemistry, &c., University of Michigan, U.S.

The pump is not always at hand; its use is forbidden for transmission of corrosive vapours; and, moreover, the removal of liquids, in form of vapour, against the weight of the air by muscular power is liable to "exhaust" the operator more effectively than it does the material. I desire to ask attention to some uses of ordinary distilling apparatus, for the production and maintenance of approximate vacuum over liquids during their vapourisation, in cases where the heat of 120° to 150° F. may be applied.

It is necessary that the distilling apparatus be made capable of air-tight closure, and that the air be removed from it to begin with. Then the degree of exhaustion in the apparatus is in direct ratio to the rapidity of condensation of the vapour produced. And the rapidity of condensation is only limited by the degree and extent of refrigeration employed, with a given extent of evaporating surface at a stated temperature. The air in the apparatus, to begin with, may be expelled through a suitable aperture by steam, which may be generated in the "receiver" of the apparatus or in an attachment thereto.

Take two round-bottomed glass flasks, the one having a capacity four to eight times greater than the other. Adjust the smaller upon a water-bath, the larger, at 10 or 15 inches distance from the other, over a sink or large basin, and connect the two with glass tubing and perforated caoutchouc stoppers, so that the connecting-tube shall incline slightly downward from its bend close to the stopper of the small flask. The stopper of the small flask is also to have a second perforation, in which is fitted a straight glass tube, 2 or 3 inches long, its lower end placed even with the lower end of the stopper. The upper end of this tube is very slightly drawn out for ¼ of and inch, and snugly fitted with 1½ inches of firm rubber tubing, the upper ½ inch of which is closed with a piece of glass-rod of same diameter as the body of the tube.

Now put an ounce or two of water in the large flask, and the material to be evaporated in the small flask; close the stoppers perfectly, by turning the flasks under

them, and leave open the straight tube. Apply, by the water-bath, the limited degree of heat until it is imparted to the contents of the small flask; then move a lamp under the large flask until the water in it has boiled briskly and the steam therefrom has escaped continuously from the straight tube for some minutes. Now close tightly the straight tube with its caoutchouc cap, at the same time removing the lamp from the large flask. When the latter has cooled somewhat, wrap it smoothly with linen netting or gauze, and lead upon it a minute stream of cold water, controlling the same as required. The liquid in the small flask boils briskly (if aqueous, boiling at 120° to 150° F.), and the refrigeration is governed to prevent too violent ebullition, lest liquid be thrown into the connecting-tube: the degree of applied heat is governed to the same end.

An ordinary glass retort may be substituted for the small flask as an evaporating vessel, and its tubule may be fitted with a perforated stopper, admitting a thermometer. If there is not room in the stopper (of retort or flask) for both the thermometer and the steam-escape tube, the latter may be dispensed with by adjusting the stopper loose for escape of steam, and pressing it tight when the air is expelled. Flat-bottomed flasks favour equable boiling, but they are liable to collapse.

As a *condenser*, I have used, instead of the large flask, a copper vessel, for more ready application of heat without danger of breaking, and for more efficient refrigeration. This copper receiver (Fig.) is made of conical shape, with rounded bottom, a vertical diameter twice its horizontal diameter, and a neck bent to the angle of about 56° with the vertical axis of the vessel. The diameter of the neck is ¾ of an inch, to receive a retort beak, the joint being covered with a section of caoutchouc tubing. Or it may be fitted with a perforated stopper, to receive the connecting-tube of the flask when evaporation is conducted in the latter.

With linen netting to spread the water over the free surface of the condensers, the evaporation therefrom refrigerates with a comparatively small supply of water. Using a copper condenser of the above-described shape, a vertical diameter of 12 inches, and capacity of 6 pints, attached to an 8-ounce glass retort containing distillation promoters, I have vapourised 4 fluid ounces of water in sixteen minutes at the constant temperature of 128° F. By ordinary care in the expulsion of air and closure of the apparatus, exhaustion can be invariably secured, fixing the water boiling-point at or below 130° F.; that is, atmospheric pressure equal to at least 25 inches of mercury may be removed and sustained by availing ourselves of the displacing effect of steam, and the contraction of condensing vapour, in very simple apparatus.

Notwithstanding the illustrations of vacuum by condensation which abound upon the physical lecture-table, I do not know whether the devices suggested in this note have been tried or proposed for small chemical operations by anyone else. I have recommended them to students, and we have found them satisfactory for various analytical, experimental, and pharmaceutical operations. We have employed them chiefly in such evaporations as are performed for the residue only, or, at least, not for quantitative recovery of the distillate, in various evaporations of quantitative analysis, in the elimination of non-volatile alkaloids, in determining the organic matter in water, and in preparing fluid extracts. To evaporate at ordinary temperatures by hand-pump exhaustion is especially irksome in those cases when application of 125° to 150° F. is unobjectionable. And to connect a vessel under which heat may be applied with the air-pump involves quite as much labour as the arrangement of apparatus for exhaustion by condensation.

NOTICES OF BOOKS.

Exercises in Practical Chemistry. By A. VERNON HARCOURT, M.A., F.R.S., and H. G. MADAN, M.A. Series I., *Qualitative Exercises.* Oxford: Clarendon Press. 1869. 335 pages.

THIS joint work of Messrs. Harcourt and Madan is the last volume which has appeared in the very useful "Clarendon Press Series" of Messrs. Macmillan and Co.; and it forms the first half of a work which is to include quantitative analysis. The object of the work "is to furnish a systematic course of study to those who are beginning to learn chemistry practically;" and, with this in view, the authors have detailed, with much care and precision, the nature of, and the mode of manipulation with, all the more general apparatus, and have given in the Appendix suggestions for the construction of the simpler apparatus.

At the outset, we notice, under the head of "Memoranda," a series of ten aphorisms, embodying, in very terse language, rules for the attainment of the exactness and precision of action, and of the attitude of mind which must accompany chemical work. Such are:—

1. "Be orderly and neat in manipulation. Cleanliness stands at the head of the chemist's scale of virtues. All messes must be cleared away with the zeal of a sanitary inspector.

2. "Do not begin work in a hurry.

3. "Be economical of materials.

6. "Do not think merely of what will *do*, but what is *best*, of the means at your disposal.

10. "Finally, do not look upon chemistry as a mere amusement—as a means of getting up a few explosions, creating a few unsavoury smells, producing a few striking changes of colour. Chemistry is worthy of better treatment. It is no longer a 'black art,' but a refined science, and should be thoughtfully and reverently studied."

After the "memoranda," we have a list of the apparatus, and of the substances required for the work described. The illustrations of apparatus are, for the most part, drawn on the block direct from photographs taken by one of the authors. We do not notice the introduction of any new or modified form of apparatus; and that which is described is (as it should be) of the very simplest and cheapest description. Part I. is devoted to "Experiments on the Preparation and Properties of Substances," and this is commenced by an account of different operations, such as—"Fusion and Granulation;" "Glass-working;" "Solution, Evaporation, and Crystallisation;" "Precipitation and Filtration;" "Distillation;" Use of the Pneumatic Trough." Each of these is described with the utmost detail; for instance, more than two pages are devoted to the method of boring a cork, and more than three to the use of the pneumatic trough.

Section 2 treats of the "Preparation and Examination of Gases;" and each *exercise* is conveniently headed by a list of the apparatus and materials required for the preparation of the particular gas about to be described, even down to "cedar matches," and "a jug of water." We do not think that the list of experiments is at all sufficient; nor does there seem to be any effort to introduce new or modified effects. In the experiments in connection with oxygen, the burning of sodium in that gas is not mentioned; yet this is surely an experiment of the utmost importance, for it behoves the teacher to show the inappropriateness of the name oxygen, inasmuch as, by its combination with substances, are produced, not alone acid compounds, but also some which are neutral and alkaline. Again, the burning of naphthaline in oxygen is a very notable experiment; as, also, the burning of thallium, zinc, and aluminium. Hydrogen, nitrogen, and the protoxide and dioxide of nitrogen are next described; and an account of the collection of gases by displacement heralds "Carbon Dioxide," in the account of which we

are glad to notice the capital experiment of burning magnesium in a bottle of that gas, which is a far easier plan than the old arrangement of a bulb-tube and red-hot potassium. To separate the black flakes of carbon from the white flakes of magnesia, the bottle is to be rinsed out, and hydrochloric acid added to dissolve the magnesia. In order, follow—"Carbon Protoxide," "Ammonia," "Hydrogen Chloride," "Chlorine," "Ethylene," and "Sulphur Dioxide." Remembering to how large an extent the work before us will be used in schools, and the usual recklessness of boys, we think it behoves the authors, in the next edition, to add special precautions in regard to explosive substances. For instance, we do not think that nearly enough has been said about the danger of exploding ethylene with oxygen gas, from the careless management of which experiment a really serious accident might without difficulty arise.

Section 3 treats of the "Preparation of Reagents used in the Laboratory." The preparation of solutions of hydrogen sulphide, of chlorine, of chloride of tin, and of "Hydrogen and Silicon Fluoride," is here described. Then follows an extremely useful chapter on the "Preparation of Normal Solutions of Reagents," in which no less than thirty-seven solutions are described.

Section 4 treats of "Experiments with the Mouth Blowpipe;" and Part 1 is concluded by Section 5, wherein is detailed an "Examination of the Properties of the Principal Radicles and their Salts." Nearly one-third of the book is devoted to this subject; and explicit accounts are given of the properties and mode of examination of all the substances in most general use in the laboratory. The following may be taken as an example:—

"Place a bit of magnesium-ribbon, about 25 c.m. in length, in a test-tube, and pour on it some dilute hydrogen sulphate. Hydrogen gas will be evolved with effervescence, and the metal will gradually dissolve. When the action has ceased, pour off the liquid into a small porcelain dish, and evaporate it down until it begins to crystallise. Long prismatic crystals of magnesium sulphate (Epsom salts) will be deposited in abundance as the solution cools; these should be re-dissolved in about 20 c.c. of water, and separate portions of the solution tested as follows:—

(*a*) "To a portion, add a drop or two of solution of ammonium sulphide. No precipitate will be formed, since magnesium sulphide, unlike zinc sulphide, is soluble in water."

The other usual tests follow—sodium carbonate, ammonium carbonate, ammonia and ammonium chloride, and the blowpipe test with cobalt.

Part 2 treats of the "Qualitative Analysis of Single Salts," and is divided into six sections, of which the first explains the general nature of the analytical course; the second, the "Preliminary Examination of the Substance;" the third, the "Examination of the Solution of a Single Salt for a Metal;" the fourth, the "Examination of the Solution of a Single Salt for Non-metallic Radicle;" the fifth, the "Examination of an Insoluble Substance;" and the last, an "Example of the Analysis of a Single Salt." A general grouping of substances is given in the first section, together with a table showing the distribution of the principal metals into groups for the purposes of separation. The preliminary examination is discussed under thirty-one separate heads, and is very clear and precise. The whole subject of Part 2 is divided into seventy-four minor heads, and these are distinguished by bold and black figures placed near the margin. The extent to which printers' type can indicate a desired difference by its own difference of form is surely well shown in this work; for, in a single page, we observe no less than *nine* different kinds of type.

The work is concluded by six short appendices, whereof the first contains "Suggestions for the Construction of Chemical Apparatus;" and here we find such proposals as the conversion of a biscuit-tin into a pneumatic trough, of a door-handle into an Argand burner, and of a tobacco-pipe into a deflagrating spoon. Without doubt, it may be well sometimes for the student to exercise his ingenuity in this way; but, when we remember the extreme cheapness of all the more ordinary chemical apparatus, we do think a great deal of time is often wasted in the attempt to construct that which, after all, is but a clumsy and short-lived piece of apparatus. Appendix B discusses the recovery of gold, platinum, and silver from their residues. Appendix C contains a very useful table of the solubility of a number of salts, on the authority of Storer's "Dictionary of Solubilities." Appendix D contains "Tables of Weights and Measures." Appendix E treats of "Thermometric Scales." And, finally, Appendix F discusses the nature of chemical symbols, which are very sparingly used throughout the work. The index is short, but is, perhaps, sufficiently long for a book which, to a certain extent, constitutes its own index.

Regarding the book as a whole, it may be said to contain a large and varied amount of information; the matter is condensed as much as possible, although considerable minuteness of detail is frequently apparent. We confess that the arrangement often appears to us to be complex, and we do not grasp the design which the authors had in view in certain of their modes of arrangement. Indeed, every new work on Chemistry appears to us more complex than that which preceded it; Bloxam's "Laboratory Practice" is surely a less complex (but in all fairness, be it remembered, also a less comprehensive) work than that of Messrs. Harcourt and Madan; while, to our mind, the least complex work of all is "Bowman's "Practical Chemistry." It will be borne in mind that we speak here solely of arrangement of matter and simplicity of style. Perhaps we are too conservative in all this; perhaps we like too much *stare super antiquas vias*, but, truly, we think that much of the chemical literature of the period is characterised by unnecessary complexity and obscurity. At the same time it is undeniable that Chemistry itself is advancing in the same direction, and so long as this continues to be the case, we cannot expect to have a different literature. The importance of an extreme simplicity in the mode of teaching a new and difficult science to boys cannot be exaggerated. A boy with some glimmer of a taste for science will, if he meet with a rebuff at the outset, probably abandon the study altogether. The questions which boys ask after hearing a lecture indicate how they often unwittingly create difficulties, and in the abstruse branches of analysis these difficulties must more frequently arise. Let it be remembered, however, that Messrs. Harcourt and Madan have had much experience in science teaching, and we may feel very sure that they have embodied the sum and substance of that experience in the work before us. They are both well qualified to write on the subject, and they have done justice to it. Their work appears very opportunely, for now, more than ever, is the establishment of school laboratories and science classes receiving the attention of all who are interested in the educational progress of this country, and we are well assured that the work we have been considering will be much used both in the higher classes of our schools and in our universities.

The City of London Gas Act.—We have received from Dr. Letheby his report on the results of the daily testings of the gas supplied to the City during the quarter which ended on the 30th day of September last, from which we find that the maximum illuminating power of the Cannel gas supplied by the City of London Gas Light and Coke Company has been equal to 27·50 standard sperm candles, the minimum to 19·50 candles, and the average to 24·58. The gas supplied by the three companies has been free from sulphuretted hydrogen, but the proportions of sulphur have fluctuated to a large extent. Ammonia has also been found in the gas supplied by the Chartered Company. The use of Sugg's New London Argand Burner of 24 holes shows an increase of illuminating power of sixteen per cent.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, October 25, 1869.

The following original papers and memoirs bearing upon chemistry and physical science are contained in this number :—

Remarks on the Communications made by MM. Vergnette, Lamotte, and Thenard.—M. Pasteur.—The author of this lengthy and criticising review condemns, in terms fortunately not frequently heard in the Mazarin Palace, the processes of the preservation of wine by heating it. The paper is too lengthy to admit of abstraction, and is, moreover, only of interest to wine-growing countries.

Fundamental Equations of the Mechanical Theory of Heat.—M. Reech.—A purely mathematical paper.

Illumination of Transparent Substances by means of Polarised Light.—M. Lallemand. In order to see the illumination of any fluid, water, for instance, it is poured into a glass tube, which is closed at both ends by means of pieces of plate glass; the tube is then placed in a dark chamber in a horizontal position, and a ray of polarised light is made to shine upon the tube, which, when looked at sideways, will exhibit a vivid glimmering; but, seen in any other direction, the tube remains dark. Hence, it follows that the propagation of the light takes place in the direction of the plane of polarisation; and it also follows that the vibrations of the waves of the ether take place in the perpendicular direction. When, instead of water, any other fluid is taken which is endowed with rotatory power—a solution of sugar, for instance—a very beautiful chromatic effect is displayed; the colours of the spectrum will be seen distributed in an elliptical shape. Cylinders of solid glass, submitted to the same experiment, exhibit somewhat similar phenomena, but less conspicuously than fluids.

Calorific Rays Emitted by the Moon.—M. Marié-Davy.—The author retracts his former negative statements on this subject, and now proves that, by another, and differently-conducted set of experiments, he found that the moon emits calorific rays in abundance. The secretary read, also, a memoir on this subject, by M. Volpicelli, who, quoting the observations of more ancient and modern *savants*, comes to the conclusion, also, by his own observations, that the moon emits heat.

Bronzing of Copper.—M. Zalewski.—When objects made of copper are immersed in molten sulphur wherein lamp-black is kept suspended, the objects so treated obtain the appearance of bronze, and can be polished without losing that aspect.

Influence which Divers Luminous Rays Exert upon the Decomposition of Carbonic Acid, and the Evaporation of Water from the Leaves of Plants.—M. Dehérain.—The author, having extended his experiments on this subject, now states that all the luminous rays are not equally active in the decomposition of carbonic acid; that, even when the intensity is the same, the yellow and red rays act more favourably than the blue and violet rays; that the relation between decomposition and evaporation remains unaltered.

Preparation of Oxygen.—M. Delaurier.—The author states that, when manganate of lime is heated, oxygen is abundantly given off, and that by means of this salt it may be made very economically.

Metrical Weights and Measures.—M. Jacobi writes to the effect that the Royal Prussian Academy of Sciences is favourably disposed towards the proposal to establish an international committee for weights and measures.

Testamentary Disposition by M. Lacaze.—The perpetual secretary, M. Dumas, announces that the late M. Lacaze has bequeathed to the Academy a sum of 10,000 francs (£400), the interest of which is to be applied, bi-annually to the distribution of prizes for chemistry, natural philosophy, and physiology.

The Journal of the Franklin Institute, September, 1869.

This number contains the following original papers and items :—

Gas Blasting.—While an excavation for a gas-holder tank was being made at Oswego, an old well had been pumped out and then filled up, after leaving an aperture beneath. Into this space a limited quantity of gas was introduced from the gas pipe, sufficient to form an explosive compound with the air in the covered well; this mixture being exploded by suitable means, caused a general upheaving of the surrounding earth, loosening the soil, and making digging easier.

Analysis of Hathorn Spring Water.—Dr. Chandler.—Grains to the gallon—Chloride of Sodium, 509·968; chloride of potassium, 9·597; bromide of sodium, 1·534; iodide of sodium, 0·198; fluoride of calcium, a trace; bicarbonate of lithia, 11·447; bicarbonate of soda, 4·288; bicarbonate of magnesia, 176·463; bicarbonate of lime, 170·646; bicarbonate of strontia, a trace; bicarbonate of lime, 1·737; bicarbonate of iron, 1·128; phosphate of soda, 0·006; biborate of soda, a trace; alumina, 0·131; silica, 1·200; organic matter, a trace; total solid constituents, 888·403 grains; carbonic acid gas in one gallon, 375·747 cubic inches; specific gravity, 1·009.

Various Processes for Preserving Timber.—Dr. Ott.—From this paper, which is to be continued, we learn that the first attempts in this direction were made by the German chemist Glauber, and consisted in first charring the surface of the timber, then coating it with Stockholm tar, and immersing it in crude acetic or more properly pyroligneous acid. The author then reviews at length the various methods applied for the preservation of timber, treating of injection with brine, or salting timber, which is not of much use unless, indeed, the salt could be made to penetrate through the very heart. Speaking of Mr. Beer's process, that is to say the treatment of wood in a boiling solution of borax in water, the author observes that beside the ready solubility of borax in water (one part in twelve of cold water), borax, like all alkaline salts, has the property of dissolving, or at least attacking, the so-called incrustating matter of the wood, upon which its strength, solidity, and toughness greatly depend; moreover, borax also dissolves the resin which is therefore eliminated from the wood, and in regard to its (borax) claimed superiority in withdrawing the putrefiable substances, it may be stated that not less than 14 per cent of the original amount of albumen have been retained in saw-dust, after boiling it several times, and each time for hours with a saturated solution of borax.

Cosmos, October 23, 1869.

Extracts from Vegetables.—M. Berjot.—This gentleman has applied to the vegetables in ordinary use for culinary and domestic purposes the process long since very successfully carried out for vegetables to be used in pharmacy, viz., of expressing by strong hydraulic pressure the juices of such vegetables, and concentrating the same by evaporation *in vacuo*, and preparing extracts thereof suitable for making soups and sauces, 1 gramme of these extracts being sufficient to convert 1 litre of bouillon into a good soup.

Porte-plume-encrier Vélocigraphe.—Dr. Poznanski.—Under this title is described at great length, accompanied by a woodcut, an instrument which, if what is stated about it is correct, will, in a very short time, be greatly in demand by all who have much writing to do. The instrument is a combination of pen-holder, pen, and ink reservoir, and the ink flows into the pen by means of a self-acting valve and piston, as long as the writer requires it; we cannot give more details without re-producing the cut.

Estimation of Urea.—Dr. Byasson.—Take 50 c.c. of the urine to be tested from the urine in a flask, and next add 25 c.c. of baryta water, and shake the mixture, filter off the precipitate, the filtrate from which should be alkaline; take 10 or 20 c.c. of this filtrate, and pour it in a vessel suitable for precipitation, and place the vessel on a sheet of white paper; then add from a graduated burette a mercurial solution (made by dissolving 36 grammes of red oxide of mercury in 50 grammes of nitric acid diluted with as much water; this dissolution is aided by heat and carried on until, by evaporation, red fumes are beginning to be given off, when the saline mass is dissolved in 1 litre of distilled water), keeping the fluid well stirred. From time to time small quantities of a solution of caustic potassa of 25 grammes to the litre are added; by this proceeding a yellow precipitate is formed. This first assay is only approximative, and should be followed by at least two other similar operations. Every c.c. of the mercurial liquid applied represents 0·005 gramme of urea; the mercurial solution is controlled by means of a urea solution made by dissolving 20 grammes of crystallised urea in 1 litre of distilled water.

Zeitschrift für Chemie von Beilstein, No. 19, 1869.

This number contains the following original papers :—

New Method for the Synthetical Preparation of Salicylic Acid and its Homologues.—M. Vogt.—The author says—Some few months ago, M. Oppenheim and I proved that chloride of phenyl is not readily acted upon by fusing caustic potassa, unless that chloride is converted into the corresponding sulpho-acid. While the writer was engaged in experiments with chlorinated toluol and xylol, expecting to obtain orcine and β orcine, the result was the formation of salicylic and cresotinic acid. Chlorinated toluol was mixed with fuming sulphuric acid, and afterwards submitted to heat; as soon as the chlorinated compound was dissolved, the mixture was diluted with water, and baryta solution was added, until a precipitate ceased to appear. The liquid was next filtered, and neutralised with a solution of carbonate of potassa; in this manner a salt, $C_7H_5ClSO_3K$, was obtained in pearly plates. This compound was fused with caustic potassa, and, after a lengthy purifying treatment, first with water, next hydrochloric acid in excess, then ether, and again saturation with carbonate of potassa, and decomposition, again, of the saline mass by excess of an acid, salicylic acid was obtained, in small quantity, but sufficient to test its most prominent features. Bromated toluol,

treated in the same manner, yields the same result. Chlorinated xylol, submitted to the same treatment, yields cresotinic acid, a solid substance which crystallises in elongated prisms, fuses at 148°, difficultly soluble in water, and yields, with chloride of iron, a violet tinge.

Action of Deutoxide of Nitrogen upon Terpen.—M. Bunge.—The author says—Some thirty years ago, M. Cahours published a paper wherein it was stated that deutoxide of nitrogen combines with the terpen of essential oil of feuchel, yielding a substance, $C_{13}H_{21}(NO)_4$, which, consequently, is a nitroso hydrocarbon. These researches of the last-named author have been repeated by the author of this paper, with the following results:—(1) Pure deutoxide of nitrogen does not combine with the terpen of essential oil of feuchel, and is hardly even absorbed by it; (2) when the deutoxide of nitrogen is brought into contact with the aforesaid terpen, air being at the same time admitted, the compound described by Cahours is formed; (3) pure hyponitric acid, prepared from nitrate of lead free from chlorine, is plentifully absorbed by the terpen alluded to, but the result is not the formation of a crystalline substance; (4) when the terpen is mixed with an aqueous solution of nitrite of potassa, to which some acetic acid is added, the terpen is thereby converted into a crystalline mass, which, although identical with that described by M. Cahours, differs from it in composition, its formula being $C_{10}H_{18}(N_2O_4)$. Ordinary oil of turpentine (purified, of course), and the terpen from Copaiva balsam, do not yield, when treated as described, crystalline compounds. When the nitrate of lead, employed for the evolution of hyponitric acid, contains chlorine, or if, purposely, chloride of lead is added to the nitrate, and the gas thus obtained be passed through the terpen of essential of feuchel, this fluid soon becomes turbid, and the result is the formation of a substance insoluble in water and hardly soluble in either absolute alcohol or ether; this compound is expressed by the formula $C_{10}H_{14}NO_3Cl$. The terpen of copaiva balsam yields an analogous compound.

Formation of Green Sulphide of Manganese by the Wet Way.—M. Muck.—When the salmon-coloured sulphide of manganese is submitted to heat while yet in moist state, it becomes green. The author distinctly states that the green sulphide alluded to is not identical with that obtained by the dry way. After quoting several observations of the same phenomenon recorded by other scientific men, the author says—The salmon-coloured sulphide of manganese, when seen under the microscope with a magnifying power of from 200 to 300 diameters, is observed to be a completely amorphous substance; the green sulphide, however, exhibits, under the same conditions, greenish coloured transparent quadratic tables. The preparations of manganese applied for the purposes of experiments, are perfectly pure, and quite free from any other metals precipitable by hydrosulphuret of ammonium. The results of a series of researches on this subject are, that, when an excess of hydrosulphuret of ammonium is applied as precipitant:—1. Very dilute and cold solutions of the chloride and sulphate of manganese yield a salmon-coloured MnS, which, even when kept for several weeks, does not exhibit the least tendency to become green coloured. 2. The same solutions, when precipitated while hot, yield flocculent precipitates, which are bright green-coloured; the solution of the sulphate yields a precipitate akin in colour to the hydrated oxide of chromium. 3. When the same solutions are quite concentrated, the precipitates formed are, at first, salmon-coloured; but, after a short time, and even without the application of heat, the precipitates, while shrinking enormously, and becoming pulverulent, get green-coloured. When a large proportion of a solution of chloride of ammonium was added to the solutions of the salts of manganese just alluded to, previous to adding the precipitant, a nearly blackish green, very dense MnS was thrown down. The following salts of manganese, in solid state, behave towards hydrosulphuret of ammonium in the manner thereby respectively expressed:—The chloride is rapidly converted into a green sulphide, even at the ordinary temperature of the air; the sulphate is more slowly acted upon, but the result is the same; the nitrate, solid as well as solution, is only partly converted into a green sulphide; the phosphate and oxalate yield, rapidly, a green sulphide; the carbonate never yields a green sulphide, but always the salmon-coloured. A concentrated solution of the chloride of manganese yields, on being precipitated by the hydrosulphuret of ammonium only, then, a green sulphide of manganese when the precipitant is in excess and all the metal thrown down; the green sulphide yielded, on careful analysis, by means of drying in a current of dry sulphuretted hydrogen gas, 7·43 per cent of water. When, instead of hydrosulphuret of ammonium, the various soluble sulphides of potassium or sodium are applied as precipitants, the author never obtained a green sulphide of manganese under any conditions.

Conditions under which the Sulpho-Carbanilide and some Analogous Substances are Decomposed.—MM. Merz and Weith.—The subject treated of in this lengthy essay may be summarised in the following manner:—The authors proved that nascent hydrogen has the effect of desulphurising sulphocarbanilide; but, instead of obtaining, as they expected, methylendianiline, other products appeared. This phenomenon they attributed to the presence of acid, and, therefore, they repeated experiments formerly made, and applied perfectly neutral solutions; but this precaution, notwithstanding the sulpho-carbanilide, was decomposed as before. The paper contains, further, a lengthy description of the origin and products of decomposition of a number of complex organic substances, as, for instance, triphenyl-guanidine, sulpho-carbanilamide, tricarbo-hexanilide, and others.

Action of Permanganate of Potassa upon Quinine.—Dr. Kerner.—One part of pure quinine is dissolved in excess of pure nitric or hydrochloric acid; the solution is heated to about 50° or 60°, and there is added to it a concentrated solution of two parts of permanganate of potassa in water at the same temperature, and the liquid well stirred and heated some 15° or 20° higher. The fluid is separated by filtration, from the precipitate of peroxide of manganese, and next evaporated to about one-eighth of the original bulk. The liquid, which should exhibit an alkaline reaction, is next acidified, upon which the new substance, dihydroxyl of quinine, is precipitated; this material will require to be purified from colouring matter by means of a very dilute solution of soda. The purified substance, after having been re-crystallised from its aqueous solution, exhibits a crystalline material, difficultly soluble in cold water and alcohol, and more readily so in these fluids when hot. Its composition is represented by $C_{20}H_{26}N_2O_4$; its formation from quinine may be represented by—

$$C_{20}H_{24}N_2O_2+H_2O+O=C_{20}H_{26}N_2O_4.$$

On Oxytolliden.—MM. Limpricht and Schwanert.—When an ethereal solution of toluylen is treated with bromine, there is formed, besides bromated compounds, a substance, $C_{14}H_{10}O_2$, which the authors call oxytoliden, in pure state exhibiting a solid crystalline substance, fusing at 172°, subliming at a higher temperature, without decomposition, soluble in ether and alcohol, not acted upon by an alcoholic solution of potassa, neither by reducing agents. The authors obtained, by means of the action of chlorides of phosphorus upon this oxytoliden, chloroxytoliden, $C_{14}H_9ClO_2$, a solid substance, fusing at 57°, and soluble in alcohol; trichloroxytoliden, $C_{14}H_7Cl_3O_2$, also a solid substance, fusing at 87°, and readily soluble in warm alcohol; pentachloroxytoliden, $C_{14}H_5Cl_5O_2$, a solid matter, fusing at about 190°, and difficultly soluble in hot alcohol. The structure of oxytoliden is represented by—

$$\begin{matrix} C_6H_4-O-CH \\ \quad\quad\quad\quad | \\ C_6H_4-O-CH \end{matrix}$$

On Thionessal, Tolallylsulphide, Lepiden, and Oxylepiden.—Dr. Dorn.—Thionessal, $C_{28}H_{20}S$, is not readily desulphurised, even by being heated to a feeble red heat along with either iron or copper filings. The heating of thionessal with chloride of phosphorus also fails to effect desulphuration; but there is formed a bichloride of thionessal, $C_{28}H_{18}Cl_2S$, a solid substance, fusing at 219°. Tolallylsulphide resists the action of red-hot copper; but, on being treated with chlorate of potassa and hydrochloric acid, it is readily converted into oxylepiden, and therefore the formula of tolallylsulphide ought to be $C_{28}H_{30}S$. Oxylepiden, $C_{28}H_{20}O_2$, when acted upon by reducing agents, is converted into lepiden, $C_{28}H_{20}O$, which does not, however, give up any more of its oxygen to any reducing agents; and when it is treated with chloride of phosphorus, yields a series of products of substitution, containing chlorine—viz., bichloroxylepiden, $C_{28}H_{18}Cl_2O_2$; bichlorlepiden, $C_{28}H_{18}Cl_2O$; pentachlorlepiden, $C_{28}H_{12}Cl_5O$; hexachlorlepiden, $C_{28}H_{14}Cl_6O$; and octochlorlepiden, $C_{28}H_{12}Cl_8O$. All of these are solid substances.

The Pyromucic Acid Group.—M. Limpricht.—The combinations of this group can, according to this author, be deduced from a hydrocarbon—

$$\begin{matrix} HC=CH \\ | \quad\quad | \\ HC=CH \end{matrix}$$

In order to prove this statement, a series of experiments have been made, which are recorded in this paper. Pyromucic acid in aqueous solution is decomposed by bromine, with evolution of carbonic acid, according to the following formula:—

$$C_5H_4O_3+H_2O+Br_2=C_4H_4O_3+CO_2+2HBr.$$

There are simultaneously formed a bromo substitute, an oily substance, and, under conditions which are not precisely defined, a compound, $C_4H_3BrO_3$, a solid, insoluble in water, alcohol, and ether, and fusing at 84°. Among the products of the complete decomposition of an aqueous solution of pyromucic acid, fumaric acid, $C_4H_4O_4$, occurs; and this acid, treated with sodium amalgam at 180°, yields succinic acid.

Arsenic in the Soda of Commerce.—Dr. Fresenius calls attention to a fact, accidentally discovered by him, that the carbonate of soda (neutral), as met with in crystallised state, and as manufactured at the alkali works, now often contains a very perceptible quantity of arseniate, or arsenite of soda, undoubtedly due to the use of sulphuric acid for converting the common salt into sulphate of soda, which acid contains arsenic, derived from the pyrites of which few are quite free from arsenic, and some of which contain that substance in considerable quantity. The tests applied for the detection of this arsenic were not the most delicate in use for this purpose; and the quantity found, though small, is sufficient to affect the purity of preparations for medicinal and chemical use.

Les Mondes, October 28, 1869.

From this number we abstract the following original communications and papers:—

Electrical Explorator.—M. Trouvé.—Although this subject does not exactly bear upon chemical science, we may call attention here to what is stated in the original. The explorator alluded to is a small instrument destined to detect, by means of electricity (galvanic current), any metallic or other objects, but especially rifle-balls and pieces of shot and shell, which may have penetrated the body or limbs of men and animals. At an Exhibition, recently held at the Hague, of objects relating to army surgery, and the necessary means of taking care of the wounded in battles, Dr. Winkhuijsen, physician to His Majesty the King of the Netherlands, ingeniously introduced, in limbs made of plaster of Paris, different projectiles of iron and lead, and was thus enabled to exhibit the action of this very useful instrument, by the aid of which, even though no open wounds exist, the presence of such projectiles may be readily detected with certainty, and the extraction

proceeded with. Not only metallic, but also stone and wooden objects, which might have penetrated, can be detected.

On Combustion.—M. A. Boilot.—The author's chief conclusion on this subject is, that the distinction between supporters of combustion and combustibles is a pure fiction; there are neither combustibles, nor supporters of combustion, nor, also, any inert substances. In all reactions, each substance brings with it a portion of caloric, and absorbs a certain quantity thereof. Incandescence and heat are, in many cases, principally, if not solely, due to oxygen, but equally so to other bodies under other conditions. Oxygen is not only a supporter of combustion, but it is as much a combustible as the substances which burn in it.

Galvanic Tinning.—M. Maistrasse-Dupré.—The author, it appears, has been commissioned by the French government to apply, by galvanic means, tin upon divers objects which had been made of so-called galvanised iron—that is, iron covered with zinc. To this purpose he applied galvanic elements made of copper and zinc plates, the length of which is 1·20 metres, the width 0·70 metre, placed in a leaden trough, and separated and isolated by means of wooden partitions. The copper sheet was immersed in a mixture of equal parts of acetate of lead and common salt; and the zinc element was placed in weak sulphuric acid, sp. gr. 1·060. This battery remains in constant action and working order for eight days, at an outlay of only 2 francs. When the objects which are galvanically tinned are afterwards heated to the melting-point of tin, the goodness and durability of hot-tinned materials is thus obtained. Copper thus tinned (galvanically), and afterwards heated, is superficially converted into bell-metal, while the method of tinning galvanically has the great advantage over the old method, that it can be applied to objects to which the method of tinning in ordinary use is not applicable.

Automatic Steam-Boiler Feeding Apparatus with Constant Level.—M. Macabies.—In a few words, we call attention to an excellent piece of useful apparatus, not a toy or complicated mechanism requiring highly-skilled labour for superintendence. It is placed on the boiler, and, as soon as steam is up, begins its work, and acts uninterruptedly, pumping, or rather sucking, either cold or boiling water, even from great depths, and forcing it regularly into the boiler. There are no parts in the apparatus liable to get out of order; and, though its construction and mode of action could not be well understood without woodcuts, its main principle and action is that of the well-known Monte-Jus.

New Source of Quicksilver.—A layer of quicksilver ore has been recently discovered in the district of Sarawak, Borneo, which ore promises to be one of the richest in the world. A trial of a large quantity of this ore has been made, and proved to yield from 70 to 80 per cent of metal; this ore is, therefore, very nearly pure sulphide of mercury, and is of very rare occurrence, since the average of mercury ores yet known do not contain more than from 2 to 20 per cent of metal. Borneo is rich in minerals of all sorts, and the ores found there are of exceedingly good quality.

Researches on Tobacco.—M. Schlœsing.—Most of our readers will be aware that the sale of tobacco is a monopoly of the French Government; but it is not so generally known that, at the very extensive central manufactory at Paris, there is established a very well-arranged chemical laboratory, where researches are being continually conducted with tobacco, in its various stages of preparation, as well as in its green, or, rather, raw-dried state. There are very few substances produced, either by the vital functions of plants or animals, which contain so large a variety of different chemical compounds as tobacco does. The inorganic substances it contains are:—Potassa, lime, magnesia, oxides of iron and manganese, ammonia, nitric, sulphuric, hydrochloric, and phosphoric acids, and silica. The organic substances are:—Nicotine, $C_{10}H_7N$; malic, citric, acetic, oxalic, pectinic, and ulmic acids; nicotianine; a green and yellow resin; wax and fat; albumenoid substances; and cellulose. Nicotianine, also known as tobacco camphor, is a fatty substance, exhibiting the pleasant aromatic odour of tobacco-smoke, and having an aromatic bitter taste. Nicotianine is probably identical with coumarine. Nicotine is an organic base; it is, in the pure state, a colourless, oily liquid, of very acrid taste; soluble in water, alcohol, ether, and oil; and a most dangerous poison. According to the author, the quantity of this substance contained in 100 parts, by weight, of dry unmanufactured tobacco-leaves, ripped from the stems, varies considerably, even for tobacco cultivated in France, from 7·96 to 3·24 per cent; for American tobacco, the quantity varies from 6·87 to 2·29 per cent; while the so-called Habana (properly Cuba) tobacco contains only 2·0 per cent of this alkaloid. Snuff, which contains on an average 33 per cent of water, contains 1·36 per cent of nicotine. The quantity of ash contained in tobacco in dry state varies from 19 to 27 per cent. 100 parts of the ash contain:—Potassa, 29·96; soda, 2·76; lime, 39·53; magnesia, 9·61; chloride of sodium, 9·65; sulphuric acid, 2·78; silica, 4·51; phosphate of peroxide of iron, 4·20. The more or less easy combustibility of tobacco does not depend upon the quantity of nitre it contains, since experiments made by the author have proved that the Kentucky tobacco, which contains a large quantity of saltpetre, burns badly, while Java, Maryland, and Hungarian tobacco, which contain hardly any saltpetre at all, burn very well. The author found that tobacco which burns badly, or not at all (at least, not so as to be suitable for the use of smokers), burns very well after having been steeped for some time in an aqueous solution of an organic potassa salt (oxalate, malate, citrate, or tartrate answer the purpose), and next dried. A well-burning tobacco becomes badly-burning, or even non-combustible, by being steeped in aqueous solutions of sulphate of lime, chloride of calcium, magnesia, or ammonia. The rationale thereof lies in the fact that the organic salts of potassa just alluded to yield, on combustion, a very bulky, porous, and light coal, which burns off readily on access of air. This paper contains some very important facts relating to the preparation of tobacco and snuff, obtained on a very large scale, working with some hundreds of thousands of tons annually.

Polytechnisches Journal von Dingler, second number for September 1869.

This number contains the following original papers relating to chemistry:—

Construction of Sulphate Furnaces (Sulfatöfen).—M. Lunge.—This paper is an excellent contribution to the technology of the manufacture of soda by M. Leblanc's process; but the paper is not well suited for abstraction, since there are added to it several engravings absolutely required for the proper understanding of the subject.

Manufacture of Sulphate of Alumina.—M. Pemberton.—Hydrate of alumina is mixed with sulphuric acid and water in the requisite proportions for the formation of neutral sulphate of alumina, $Al_2O_3.3SO_3+18HO$; the best proportions are 150 kilos. of moist hydrated alumina, containing 38 per cent of that hydrate, and 200 kilos. of sulphuric acid at 58° Beaumé (sp. gr., 1·678). These quantities yield from 325 to 340 kilos. of neutral sulphate of alumina, which crystallises readily. It should be borne in mind that no larger quantities than those just named should be operated with at one and the same time, because the chemical action which sets in is very violent, and if the heat thereby evolved becomes too great, the operation is spoiled.

Preparation of Indium in Pure State.—MM. Röszler and Wolf.—The authors make use of the Freiberg zinc for the purpose of obtaining indium. The zinc is dissolved in hydrochloric acid, and next boiled with excess of metallic zinc, whereby a spongy metallic precipitate is obtained of the following composition:—Lead, 1·36; tin, 0·02; cadmium, 0·13; copper, 0·004; indium, 0·075; together, 1·529 per cent of the metallic zinc employed. This mass is first treated with sulphuric acid to remove the lead. The whitish-coloured mass is next treated with boiling water; this solution is again treated with zinc, whereby a spongy metallic mass is obtained, which is acted upon by strong nitric acid, the excess of which is evaporated, and the oxides of tin and any remaining sulphate of lead are eliminated. The residue is taken up with water, to which ammonia is added, whereby the oxide of indium is precipitated; and, after drying, this oxide is reduced to the metallic state by means of cyanide of potassium.

Artificial Preparation of Anthracen.—Dr. Greiff.—The author prefers the preparation of anthracen from asphalte or pitch, instead of coal-tar, since the purification of the product is more readily effected when it is obtained from solid substances, by sublimation, in a manner somewhat similar to the manufacture of carbonate of ammonia. Too much and too long heating should be avoided. The quantities of anthracen yielded by tar, as well as by asphalte, vary greatly, and the cause thereof is not at present well ascertained.

Keeping Water in Tanks made of Zinc.—M. Ziurek.—The author calls attention to the fact that water kept in zinc vessels (reservoirs), or, also, collected from roofs covered with that metal, is invariably contaminated with that metal, and that the use of such water, either for domestic or industrial purposes, is highly injurious to health. The author recommends that, where zinc vessels are used for the purpose indicated, they should be painted over with asphalte varnish or any iron pigment.

Journal de Pharmacie et de Chimie, October, 1869.

This number contains the following original papers:—

Chlorides of Acetylen and Synthesis of the Chloride of Julin.—MM. Berthelot and Jungfleisch.—The authors have made perchloride of antimony act upon acetylen, which is very readily absorbed by this chloride with evolution of great heat, in consequence it becomes necessary to moderate the action, so as just to keep whereof the mixture in fluid state. On cooling, magnificent large crystalline lamellæ are deposited, which are a compound of acetylen and perchloride of antimony, $C_4H_2SbCl_5$. This compound is very unstable; it is immediately decomposed by water, and on the application of heat it is converted into perchloride of acetylen and protochloride of antimony, $C_4H_2.SbCl_5=C_4H_2Cl_2+SbCl_3$. Protochloride of acetylen, $C_4H_2Cl_2$, is a clear, colourless, very mobile liquid, exhibiting, in a high degree, the smell of chloroform; its taste is somewhat sweet, and its vapour causes headache; it boils at 55°; water, as well as moist air, decomposes it slowly; and if heated, along with water up to 180°, it is decomposed into hydrochloric acid and some volatile products. Heated to 360° in a sealed tube, it is entirely decomposed into a black carbonaceous mass and hydrochloric acid, without giving rise to any secondary products. Perchloride of acetylen, $C_4H_2Cl_4$, is a colourless fluid, exhibiting the smell and taste of chloroform; it boils at 147°; heated to 180°, along with water, it is slowly decomposed; brought into contact with chlorine gas, it is converted into sesquichloride of carbon. By cautiously treating this compound with an alcoholic solution of caustic potassa, hydrochloric acid is withdrawn, and protochloride of acetylen formed. Heated to 300°, for at least twenty-four hours, in a sealed tube, the chloride of julin is formed, which is obtained even better by allowing the heat to act up to 360° for 100 hours consecutively. The chloride of julin is identical with perchloride of benzine.

Boiling and Melting Points.—M. Fleury.—The determination of temperatures requires a correction for that portion of the column of mercury of the thermometer which is not itself immersed in the hot

medium. This correction is very liable to error, which may amount to even 10° or 15°. The author proposes the use of a metastatic thermometer.

Researches on the Bleaching of Tissues.—M. Kolb.—This paper contains the first instalment of a lengthy series of researches on this subject, but it is not well suited for abstraction.

Milk at Marseilles, and Milk in General.—M. Commaille.

Reagent for Copper and Iron.—M. Bellamy.—The alcoholic tincture of Campeachy wood, sometimes applied for the detection of bicarbonate of lime in potable waters, is, according to the author, a most valuable test for the detection of very minute quantities of iron or copper present in water. Both metals turn the colour of this tincture, when added to water containing minute quantities of the same, to a peculiar blue colour. According to the researches made on this subject, 1 grm. of iron, present in 20 cubic metres of water (rather more than 20 tons in weight), has the effect of being perfectly detectable by this tincture—that is, 1 part of metal in 20,000,000 parts of water; but after the water has been boiled, no reaction is observed. The metals are chiefly found in natural potable waters as carbonates.

Analysis of the Spring Water from Santa Catalina and Guadalupe (Canary Islands).—M. Méhu.—This spring, although only situated at 85 metres from the sea-board, does not exhibit any sign of being connected with the sea. The water of the spring is very clear, its taste saline, and the yield abundant; it reddens litmus paper; temperature, 26·66°. The dry residue from 1 kilo. of water, evaporated, and the residue dried at 180°, weighs 8·47 grms. The composition of the solid residue, expressed in grm. weight, is:—Chloride of sodium, 6·0921; chloride of potassium, 0·1080; chloride of calcium, 0·2833; bicarbonate of lime, 0·1482; bicarbonate of magnesia, 1·1654; sulphate of magnesia, 0·8766; silica, 0·1084; free carbonic acid, 1·0112. The weight of the anhydrous salts contained in 1 litre of this water amounts to 8·7828 grms. Guadalupe spring (*Gran Canaria*).—This spring is situated at a height of 210 metres above sea level, at a distance of 4 kilometres from the sea shore, and at 10 kilometres from the Santa Catalina spring. The temperature of the water of this spring is 29°, and it yields 514 litres of water per hour. The composition of the residue, after evaporation of 1 kilo. of the liquid, and drying at 180°, expressed in grm. weight, is:—Chloride of sodium, 0·11606; bicarbonate of soda, 0·79673; bicarbonate of potassa, 0·01978; bicarbonate of lime, 0·42251; bicarbonate of magnesia, 0·26473; sulphate of magnesia, 0·10700; silica, 0·11850; free carbonic acid, 1·05790. Weight of anhydrous salts to the kilo. of water, 1·845 grms.

Preparation of Nitrogen.—M. Levy.—When bichromate of ammonia is heated in a retort, that salt is converted into green sesquioxide of chromium, vapour of water, and pure nitrogen.

Revue Hebdomadaire de Chimie, October 28, 1869.

This number contains the following original papers and communications:—

Proper Mode of Sampling and Preserving the Samples of Raw Sugar for Quantitative Analysis.—M. Weinzierl.—The author calls attention to the discrepancies of the results of the analysis of raw sugars taken from the same large parcel, and submitted to investigation by different analytical chemists, in order to prove, by incontrovertible evidence, that, even when the samples are carefully taken (it is generally done by experienced brokers, who, being provided with proper tools, have thereby the means of taking from every box, cask, bag, kranjang, or basket, as the case may be, a fair sample representing the entire quantity contained in such parcel). The mode of keeping and preserving these samples may seriously interfere with the results of the analysis. For this purpose, the author has compared samples of raw sugar, kept in pasteboard boxes for 24, 48, 72, and 96 hours respectively—(1) kept in similar boxes inside lined with tin-foil; (2) kept in pasteboard boxes which were four times varnished with shellac varnish; (3) pasteboard boxes painted over with the paint ordinarily used for painting the sheet-iron sugar-loaf forms; (4) samples kept in tinned-iron boxes; and, lastly, samples kept in glass-stoppered bottles. The result of analysis of samples thus kept for 96 hours was as follows (the original sample, immediately on being taken, gave, in 100 parts—sugar, 91·70; water, 3·54; impurities, 4·76):—Sample-box 1, in 100 parts—Sugar, 92·90; water, 2·28; impurities, 4·86. Sample-box 2—Sugar, 91·90; water, 3·30; impurities, 4·80. Sample-box 3—Sugar, 92·40; water, 2·88; impurities, 4·72. Sample-box 4—Sugar, 91·90; water, 3·31; impurities, 4·79. Sample kept in tinned-iron box—Sugar, 91·80; water, 3·50; impurities, 4·70. Sugar kept in glass-stoppered bottle—Sugar, 91·70; water, 3·52; impurities, 4·78.

Reagent to Detect the Presence of Resin of Guaiacum among Resin of Jalappa.—M. Blacher.—When 50 centigrms. of pure and pulverised resin of guaiacum are mixed in a porcelain mortar with 20 centigrms. of black oxide of copper and about twenty drops of alcohol (not methylated spirits), nothing noteworthy is exhibited; but if to this mixture some fifteen drops of liquid ammonia are added, and trituration continued, there will be seen, within a minute, a beautiful apple-green colour. If this experiment is repeated, with the same quantities of material, but pure resin of Jalappa taken instead of the resin of guaiacum, the original brown colour of the latter remains predominant, and no greenish or bronzy colouration ensues. The quantities mentioned are not absolute, but the author thinks it best not to depart, in either more or less, from the same. There is formed a *guaiacinate ammoniaco-cuprique* (ammoniacal cupro-guaiacinate).

Nutritive Value of Divers Roots used as Cattle Food and for Sugar Manufacture.—M. Corenwinder.—The author has estimated the quantity of nitrogen contained in the following roots, and found that to amount, percentically:—In yellow beet-roots, 1·087 sugar beet-root, 1·044; rutabaga, 1·41; pulp of sugar beet-root, expressed by Champonnois process, 1·36. What rutabaga is is not explained. Although not an absolute criterion, the quantity of nitrogen contained in vegetables of this kind expresses fairly their average value as food, taking the other constituents into consideration.

Method for Staining Naturally White-Coloured Woods.—M. Mène.—When naturally-white-coloured woods are painted over with a concentrated aqueous solution of permanganate of potassa, which is best kept somewhat warm (tepid), it is possible thereby to give such woods the appearance of palissander or walnut wood. Different kinds of wood behave with this solution in different manner; the wood of pear and cherry trees is rapidly stained; white woods, as, for instance, the acacia (*Robinia pseudo-acacia*), resists a longer time; and resinous woods, like fir, are more difficultly acted on. The rationale is that the permanganate of potassa is decomposed by the woody fibre; brown peroxide of manganese is precipitated and fixed by the potassa, which is afterwards removed by washing with water. The wood, after having become dry, is varnished, and is, according to the author, not readily distinguished from naturally-dark-coloured woods.

NOTES AND QUERIES.

Halliday's Machines.—"A. W. N." will find, we think, the information he desires in Richardson's, Knapp's, and Watts's work on "Chemical Technology."

Bleaching Syrups.—Can some of your readers give me the following information:—What will bleach syrups (common sugar-house syrup) without expensive apparatus? Will animal charcoal effect the object to any degree?—Andrew van Bibber, Cincinnati, October 14, 1869.

Rendering and Bleaching Tallow.—(Reply to "A Tallow Melter.")—This correspondent is referred to Richardson's, Knapp's, and Watts's work on "Chemical Technology;" to Chevreul's work on Fats; and to Wagner's "Lehrbuch der Chemischen Technologie." There is a French publication on the subject in the useful series known as the "Encyclopédie Roret," published at Paris.

Tungstate of Soda, &c.—(Reply to "J. C.")—This article is not manufactured in such large quantities as to require special makers—some few manufacturing chemists make it, and also the tungstate of chromium; but we cannot name any who do so continually. If "J. C." wants these articles, he should either apply to those who sell chemicals, or to some manufacturing chemist, whose names can be found in directories.

Footpaths.—"Roadway" will find one part of Portland cement, mixed with seven or eight parts of gravel, or old hard durable rubbish, such as brick-bats, broken stones, or gravel, to make a cheap, neat, permanent, garden walk, impervious to wet, heat, or cold. I will give your correspondent any information he needs if he sends his address to me through you.—Nemo.

Footpaths.—(Reply to "Roadway.")—Your question is one which belongs to civil engineering, rather than chemistry; you do not state a very important item—viz., the natural soil you wish to make a footpath on. A very good and, comparatively, cheap footpath may be made by laying down, first, a layer of rather coarsely broken-up old bricks, next, some middling coarse gravel, and over that a layer of from 2 to 4 inches thickness of small sea-shells (bivalves). If care be taken to beat or roll the broken-up bricks and gravel well into a solid mass, the shell-covered surface may be advantageously rolled in with a heavy iron roller, and will be found to form, even on soft sub-soil, a durable and inexpensive roadway. On the continent, at least in Belgium and the Netherlands, many roadways, *chemins vicinaux et communaux*, are thus arranged, and stand moderate horse and carriage traffic admirably well. Care should be taken for the proper drainage of such roads.

Bichromate of Potash.—In answer to "Bichrome," in your last number, this article is made by Norris, Brothers, Sowerby Bridge, near Halifax; The Conacher Quay Chemical Company, 121, Newgate Street, London; by a Company at Drontheim, in Norway; and also at Baltimore, U.S. If your correspondent wants further information, and writes to me under cover to you, I will ascertain the other addresses.—Nemo.

Terra Alba.—"Selenite" thanks "Nemo" for information given and offered, and would ask further—Is any particular variety of gypsum preferred? what is the nature of Jullien's process? what precipitation is meant? how is drying effected? is the patent English? Also—If the purest gypsum answers, why the artificial product? what is the difference in cost of production of native and artificial? why is French better than English terra alba? any objection to mention uses of material?

TO CORRESPONDENTS.

Metallurgist.—(1) The latest and most complete treatise on Metallurgy is the English adaptation of Kerl, by Crookes and Röhrig; vol. i. 31s. 6d., and vol. ii., 36s., are published, and vol. iii. is in the press. (2) Mitchell's "Manual of Practical Assaying," edited by William Crookes; price 28s. These works can be obtained at our office. (3) A knowledge of your qualifications would be necessary to answer your other questions.

THE CHEMICAL NEWS.

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ON THE

ACTION OF CHLORIDE OF ZINC UPON CAMPHOR.

By M. ADOLPH ROMMIER.

ACCORDING to Gerhardt, when camphor is distilled over chloride of zinc, it changes into cymol and water, according to the following equation:—

$$C_{20}H_{16}O_2 = C_{20}H_{14} + 2HO.$$

MM. Lippmann and Longuinine,* Fittig, Koebrich, and Silke,† found great difficulty in preparing cymol from camphor, and observed during the reaction the formation of hydrocarbides homologous with benzol, which was also proved by ourselves upon repeating the experiment. Our experiments were made upon 2 kilos. of camphor, which when distilled four times over fused chloride of zinc, yielded about 700 kilos. of essence, which boiled at from 140° to 240°, and of which scarcely a tenth approached the boiling point of cymol. It was also ascertained that this essence, mixed with a solution of caustic potash, yields a product analogous to phenol. After precipitation by chlorhydric acid, 40 grammes were obtained, which, on distillation in a current of carbonic acid, yielded a small quantity of liquid, boiling below 200°, and the rest at a temperature somewhat higher. Here is the elementary analysis of this latter product:—

	Experiment.	Calculation.
Carbon	76·87	77·77 (C_{13})
Hydrogen	8·13	7·40 (H_8)
Oxygen	15·00	14·83 (O_2)
	100·00	100·00

figures which correspond to cresylic alcohol.

The first was too hydrated for analysis; it was merely heated with oxalic and sulphuric acids, and the formation of rosalic acid proved characteristic of phenic alcohol.

These phenols have a slight but decided smell of phenic alcohol, whilst cresylic alcohol, obtained from tar, has a very disagreeable odour, being less easily purified than that obtained from camphor. Finally, in the reaction of chloride of zinc upon camphor, the formation of the sundry hydrocarbides and phenols shows that, contrary to what was believed, decomposition with deflagration ensued rather than simple dehydration, since if the experiment was carried on at a low temperature, the camphor distilled without alteration, whilst if the temperature was raised to the fusing point of the chloride of zinc, a still greater quantity of camphor remained unaltered even after four distillations.

ON ARTIFICIALLY-COLOURED WINES.

By Dr. T. L. PHIPSON, F.C.S.

WHEN wine of any vintage is found to be wanting in colour, it is customary to mix it with a certain proportion of strongly-coloured wine grown in the South; for instance, with good Roussillon, &c. At Fismes and Poitiers, and probably in other parts of France, there exist, however, regular establishments where colouring-matter for wines is manufactured on a somewhat extensive scale.

* *Bulletin de la Société Chimique*, Nouvelle série tome, vii., p. 374, 1867.

† *Ibid.*, tome x., p. 78, 1869.

And in Greece the flowers of the purple Holyoaks (*Althæa rosea*, *Malva arborea*, *Rose tremiere*) are collected for the like purpose to a considerable extent.

The material manufactured at Fismes is obtained from elderberry, both from the fruit of *Sambucus niger* and *S. ebulus*. The process is very simple. 250 to 500 parts of this richly-coloured fruit, with 30 to 65 parts of alum, and 600 to 800 of water, are the proportions generally employed. It has been stated that beet-root juice, blackberries, Brazil-wood, logwood, &c., are occasionally used, but, I believe, by no means so frequently as the substances above named.

Many methods have been tried in order to detect the presence of artificial colouring-matters in wines, but, it appears, with a very small amount of success. Œnocyanine may be precipitated from the wine, and its properties, studied with care, will show at once the presence of an adulterating material; but the process is rather long and delicate. I have shown, in a note on the "Absorption Spectra Yielded by Certain Organic Substances,"* that the pure colouring-matter of the grape gives no absorption bands, but only a general absorption, increasing gradually towards the violet; whilst the colouring-matter of the purple Holyoak, dissolved in water containing a little alum, gives a distinct and wide absorption band in the neighbourhood of D. This allows its presence in wine to be detected without much difficulty; and the same method applies equally well to the colouring-matters of logwood and Brazil-wood.

I have not yet ascertained how the colouring-matter of elderberry fruit affects the spectrum, but it is not difficult to discover in wine, according to M. Fauré, by means of gelatine. The fact is that œnocyanine is easily precipitated along with the tannin when gelatine is added to red wine, whilst other colouring-matters (and, among them, that of the elderberry) are left in solution. If there happen to be not enough tannin naturally present in the liquid to precipitate all the œnocyanine, a little more must be added.

Alum will be often found in wine which is artificially coloured; it vivifies the tint, and is supposed to preserve the wine. Its presence is not only highly injurious to the health, but will effectually prevent the ripening of wine and the development of the bouquet.

The test to which I have called attention may be made as follows:—Take a specimen of the wine to be examined, and, if its colour is too powerful when examined in a thin tube by means of the prism, it must be diluted with distilled water until a proper degree of transparency is obtained. A minute quantity of alum is then added, and the specimen examined in the spectroscope. If an absorption band of any kind shows itself, the wine may be suspected.

Analytical Laboratory, Putney, S.W., Nov. 1st, 1869.

ON THE

METHODS OF ANALYSIS AND THE COMPOSITION OF VARIOUS CHEMICAL MANUFACTURING PRODUCTS.

By M. GASTON TISSANDIER.

(Continued from p. 218.)

SALTS OF SODA.

COMMERCIAL salts, or carbonates of soda, are divided into hydrated salts and dry, or anhydrous salts. In most cases, the determination of the alkalimetric standard suffices to show the value of the product. The method of preparing the standard liquid sulphuric acid, which is very important, is as follows:—

* *Journal of the Chemical Society*, Sept., 1869, p. 324.

Alkalimetric Standard Liquid.—The method which I prefer, and which may be called *méthode des tatonnements*, is as follows:—

Take pure commercial sulphuric acid, and weigh rather more than 100 grms. to the litre, in order to compensate for the proportion of water which is always contained in it. Let us suppose that 10 litres of standard liquid are required; a large bottle must first be gauged, by weighing into it 10 litres of distilled water, and marking the line made by the upper surface of the liquid with a stroke of a file. This done, half the water is poured away, and, to what remains, 1·200 grms. of pure commercial sulphuric acid are gradually added; the 10 litres are then filled up with distilled water. The liquid must now be stirred; and if the acid is of a good quality, the real composition of the normal liquid will be nearly arrived at, for the 200 grms. previously weighed will approximatively compensate the excess of water contained in the acid. The liquid will contain about 100 grms. of SO_3,HO per litre; but a mere approximation will not suffice, as extreme exactitude is indispensable. This first liquid must, therefore, be tested, in order to see whether it is too concentrated or too weak; that is, whether water or sulphuric acid must be added.

The test is easily effected with dry and pure carbonate of soda, which should estimate 92·40°, if the liquid is quite correct. It is a good plan to prepare the carbonate of soda one's self, in the following manner:—Fill, with bicarbonate of soda, a funnel, the lower part of which is provided with a plug of amianthus; wash the salt with water, so as to purify it and to eliminate the alkaline sulphates and chlorides with which it is mixed. When the rinsing-water no longer contains either chlorine or sulphuric acid, the bicarbonate of soda is pure; it must then be crystallised and calcined, when carbonate of soda is produced. To obtain still more exactitude, this is again dissolved, crystallised, and calcined, and it will then be perfectly pure and dry, and should estimate 92·40°.

In testing the alkalimetric liquid, it is a good plan to heat the carbonate of soda before weighing, and even to calcine it slightly, in order to separate the water which it may have absorbed; 5 grms. are then weighed, and their standard taken. If this proves to be too high—say, for instance, 94°—the liquid is too weak, and a small quantity of sulphuric acid must be added. By thus feeling the way, as it were, adding now more acid and now more water, a liquid is easily obtained which will give, in combination with the dry, pure carbonate of soda, a normal standard of 92·40°.

In order to avoid error, it is indispensable that the alkalimetric burettes employed should be scrupulously exact; they should, therefore, be tried—the best way of doing this is by means of the balance. A small precipitating vessel should be tared upon the pan of a sensitive balance, and distilled water poured into it from a burette. If the burette is correct, the volume of water contained between ten divisions, or 5 c.c., must be 5 grms.

Still greater exactitude may be obtained by testing the standard acid with protoxide of lead as follows:—Weigh 20 grs. of pure litharge, and heat them, in a small capsule, on a Gay-Lussac stove at 110°, until their weight no longer decreases; pour in 10 c.c. of the alkalimetric standard liquid, which, if correct, should contain 1 decigrm. of sulphuric acid, SO_3,HO; evaporate the whole to dryness on the stove, and weigh again. The increase of weight should be exactly 0·0816 grs., corresponding to the quantity of SO_3 contained in 0·1 gr. of SO_3,HO.

Too many precautions cannot be used in order to obtain a well-prepared normal liquid, which is of the utmost importance in working analyses. Some chemists are in the habit of estimating the sulphuric acid contained in 5 c.c. of the liquid; for this purpose, chloride of barium is used; and a well-performed experiment on a correct liquid should yield 0·2378 of sulphate of baryta, corresponding to 0·1 gr. of SO_3,HO.

Analysis of Dry Soda-Salts.—We will say nothing concerning hydrated carbonates of soda, which often contain more than 60 per cent of water; it is only necessary to remark that the alkalimetric standard is very important, as it often exposes the fraud of dealers. The method which we are about to describe, for analysing dry salts of soda, may also be applied to hydrated salts.

Weigh 25 grms. of the salt to be tested, dissolve in water, and filter the insoluble substances upon a filter placed above a test-glass gauged to ½ a litre. The liquid ½ litre is divided in the following manner:—

Remove 100 c.c., corresponding to 5 grms., to ascertain the alkalimetrical standard. By stating the equation—

$$\text{Standard, or number of divisions on the burette} = \frac{49(SO_3HO)}{53(CO_2NaO)}$$

the carbonate of soda per cent is obtained. Deduct 50 c.c., to estimate the chlorine, which is transformed into chloride of sodium, and 100 c.c., to estimate the sulphuric acid, which is changed into sulphate of soda. The estimation of the moisture is effected separately in a platinum crucible. Those who wish for a description of the process are referred to former chapters.

Composition of Salts of Soda.

Substances estimated.	I.	II.	III.	IV.	V.
Moisture	2·22	3·11	1·15	1·00	0·40
Insoluble matter ..	0·12	0·22	0·08	—	0·06
Chloride of sodium..	12·48	6·41	3·28	2·11	0·99
Sulphate of soda ..	8·51	3·25	2·15	1·50	0·35
Carbonate of soda ..	76·67	87·01	92·34	95·39	98·20
Total.. ..	100·00	100·00	100·00	100·00	100·00

Salts of soda derived from the refining of beet-root salts always contain a small quantity of potash, which may be easily estimated by means of bichloride of platinum.

Estimation of Caustic Soda.—Salts of soda sometimes contain caustic soda, the proportion of which may be determined in the following way:—

Pulverise part of the specimen finely, throw it into a stoppered flask, into which have been previously poured 100 c.c. of alcohol at a temperature of 40°, and stir vigorously for ten minutes. The alcohol does not dissolve the soda, while at the same time it absorbs the whole of the caustic soda. Filter under a bell-glass, in order to avoid evaporation of the alcohol; collect 50 c.c. of the liquid, which will correspond to 5 grms. of salt, saturate it with the alkalimetric liquid in the cold, adding water and a few drops of sensitive litmus, and the *standard of causticity* will be obtained. This standard allows the calculation of the corresponding quantity of caustic soda, NaO,HO, deducted from the total standard; the difference given will be the standard corresponding to the carbonate of soda.

Composition of Salts of Soda containing Caustic Soda.

Substances estimated.	I.	II.	III.	IV.
Moisture	2·10	1·50	2·48	1·38
Insoluble matter ..	0·12	0·11	0·21	0·09
Chloride of sodium	4·32	2·43	3·50	4·11
Sulphate of soda ..	8·88	1·62	2·15	2·50
Carbonate of soda	82·47	88·09	84·54	81·67
Caustic soda.. ..	2·11	6·25	7·12	10·25
	100·00	100·00	100·00	100·00

Detection of Iron and Sulphides.—Salts of soda destined for the manufacture of glass should be free from iron (which colours the glass), and from alkaline sulphides. Iron may be detected by means of sulphydrate of ammonia, or, which is better, sulphocyanide of potassium, the most sensitive reagent of that metal. If the solution of the salt under examination should contain traces of iron, it will assume a red hue under the influence of some drops of this reagent poured into an acidified liquid. To detect sulphides, boil the salt of soda to be tested in a

flask containing sulphuric acid diluted with water. The liberated sulphydric acid may be known by its smell, or by the influence which it exerts upon paper previously soaked in acetate of lead.

NITRATES OF SODA.

The analysis of nitrates of soda requires great care; for the amount of nitrate contained in them is determined by difference.

Estimation of Moisture.—Heat 5 grms. of the specimen on the stove at 120° until they no longer lose weight. The method of the closed tube, previously described, may also be employed.

Estimation of Chlorine.—Nitrates of soda do not usually contain more than from 1 to 1·60 per cent of chloride of sodium; therefore the estimation must be made upon 10 grms. with the silver liquid.

Estimation of Insoluble Substances.—Dissolve 25 grms. of nitrate of soda in water, and separate the insoluble matters by filtration. They, however, occur in but small proportions.

Estimation of Sulphuric Acid.—This is estimated on 25 grms. of nitrate of soda. The filtered liquid is now used for this purpose, having previously served to determine the quantity of insoluble substances. The sulphuric acid is precipitated as sulphate of baryta, and filtered after standing twelve hours.

Subjoined is an example of the composition of some commercial nitrates of soda, and of the way in which it is usual to formularise the analytical results obtained.

Loss per cent.	I.	II.	III.	IV.
Moisture	0·98	1·11	1·42	1·68
Insoluble matters	0·07	0·12	0·16	0·15
Chloride of sodium ..	0·99	1·10	1·41	1·60
Sulphate of soda	0·18	0·20	0·22	0·25
Total loss	2·22	2·53	3·21	3·68
Nitrate of soda	97·78	97·47	96·79	96·32
Total..	100·00	100·00	100·00	100·00

The quantity of water contained in nitrates of soda rarely exceeds from 2 to 2·50 per cent. The proportion of nitrate of soda varies between 95 and 99 per cent.

(To be continued).

ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 221.)

THE durability of objects, however mounted, is much influenced by the manner of storing them. Racked boxes and drawers are the worst possible receptacles as from the vertical position of the slides they are liable to serious injury, those in fluid being likely to become leaky, and the balsam specimens sliding down, frequently, cover and all. Arrangements should be made for keeping the objects flat, which is now always done in well constructed cabinets; it is also a great advantage to be able to see every slide, which is impossible in a racked box, and often causes much loss of time in searching for an object. For the convenience of those for whom the usual cabinets are too costly, Mr. Piper has invented some very ingenious trays, in which slides are placed horizontally; besides the merit of cheapness, they have the advantage of being extremely convenient. Five or six of these trays, with a mill-board at the top and bottom, may be fastened together with a couple of India-rubber rings, and any vacant shelf room utilised for the storage of objects; a similar bundle of two or three trays is very convenient for carrying a small selection of objects in the pocket. Dr. Carpenter has used these trays placed in wooden cases made to resemble books, a very convenient way when bookshelves are vacant to receive them.

The chief difficulty of fluid mounting will be found not to consist so much in the mechanical process of closing the object perfectly in its cell, as in the selection of a fluid suitable for its preservation.

A fluid which may be considered as a perfect medium—that is, one capable of preserving substances for an unlimited period without change, is at present unknown, and it is more than doubtful whether the discovery of such a fluid would be altogether an advantage, as use is frequently made of what some may consider the defects of preservative fluids, the alterations they induce in tissues submitted to their action often revealing facts of great importance. Some media are valuable, because they soak into tissues and render them transparent; this is the case to such an extent with glycerine, that Dr. Beale very appropriately calls it "The Canada balsam of moist tissues." Others are used for quite the opposite purpose, because they induce opacity, and very frequently do so partially, bringing out details somewhat in the same manner as is done by the colouring of a map, and which, without such aid, would be very imperfectly distinguished. Others are slightly corrosive, and clear away parts wished to be got rid of for the sake of bringing others more prominently into view.

In mentioning some of the very numerous media which have been used for mounting, the results can only be stated generally, and no fixed set of rules can be given, as the whole subject is at present in too imperfect a state. Much good might be done by observers mounting a series of the same object in different media, carefully labelling each slide with the date of mounting and the nature of the medium employed, and from time to time noticing and recording the result.

One of the great difficulties affecting the mounting of objects in fluid, arises from endosomotic action. When two fluids of different densities are separated by a permeable membrane, they will pass through and mix at very unequal rates. Supposing some dense fluid, like glycerine, enclosed in a bladder and immersed in water, the water would flow into the bladder faster than the glycerine made its way out, the result would be the expansion of the bladder. This is called endosmosis: the reverse action is known as exosmosis. With a view to observing practically the result of these actions, the student is recommended to obtain a specimen of some fresh-water conferva, such as are abundant in nearly every pond or aquarium. A portion of this conferva should be placed on a slide in a drop of water, covered with a thin glass, and examined with a power of fifty or sixty diameters. When the appearance of the plant is well impressed on the mind, remove the slide from the microscope, take off the cover glass from the object, and with a piece of blotting-paper drain off (not blot up) as much of the water as possible. Now cover the conferva with some strong glycerine, replace the cover quickly, and examine without loss of time under the microscope, and notice the change that has taken place. The fluid contents of the

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

conferva cells have suddenly emptied themselves into the surrounding glycerine, leaving the whole plant in a shrivelled and contracted state; in many cases the cells will be found to be ruptured, but those which have escaped injury will after a time expand and resume their natural appearance. In observing, advantage is sometimes taken of induced endosmosis, the tissues ruptured by this means often revealing points of structural detail difficult or impossible of demonstration by dissection. Endosomotic action may be prevented by introducing objects which contain light fluids very gradually into denser ones; for instance, an object should be passed from water into weak glycerine and then after a time into stronger, till at last it might be placed in glycerine of full strength without any contraction taking place. The same phenomenon takes place if marine plants are immersed in fresh water. This may be familiar to some who have attempted to wash delicate sea weeds, such as *Griffithsia setacea* in fresh water, the result being that the cells burst and stain the mounting paper; this may be prevented by washing in sea water, or water having gum or sugar dissolved in it, so that its specific gravity approaches that of sea water. An ingenious application of the principle of gradually increasing the specific gravity of the mounting fluid with a view to the prevention of endosmosis, will be found in the method known as Hantzsch's. The fluid consists of three parts alcohol, two of distilled water, and one of glycerine (Price's), all by measure. This medium is principally imployed in mounting *Algæ*. The specimen is placed in the cell with this fluid and the cover put on, but not cemented, so as to allow evaporation to take place; the waste is supplied from time to time, until at last the cell contains nearly pure glycerine; it is then to be cemented as before described. The fluid is of very nearly the same specific gravity as water, so little or no endosomotic action takes place on the immersion of the specimen; and as the evaporation process increases the strength of the solution very gradually, the most delicate tissues can be eventually mounted in strong glycerine; doubtless this principle would answer equally well with a solution of chloride of calcium, a very valuable medium for certain preparations. Much valuable information respecting the collection and preparation of *Algæ*, will be found in "The Collector's Handy Book of Algæ," by Rev. W.W. Spicer, from which the above process is taken.

Taking the preservative fluids in groups, the simplest consist of water, either alone or in combination with some antiseptic substances.

Distilled water alone is capable of preserving such objects as the *Desmidiæ* and other *Algæ* in tolerable perfection as to form, although with more or less loss of colour and alteration of the disposition of the endochrome or cell contents. Confervæ are very apt to grow in slides in which distilled water is used; this is best prevented by saturating the water with camphor or creosote.

Camphor water is made by placing a lump of camphor in a bottle of distilled water, and allowing it to remain a few days; the water will then be found to smell very strongly, although the quantity dissolved is exceedingly small. Such portion as may be required for use is to be filtered and kept in a small bottle; the store bottle is to be filled up from time to time with distilled water. This fluid may be used with advantage in making and diluting all the preservative fluids mentioned in these papers instead of pure distilled water, unless an indication to the contrary is given in the formula. It is capable of preserving animal tissues as well as vegetable, but with the fault of most watery liquids, that it is apt in time to induce a granulous texture in objects of this kind mounted in it.

Creosote water is made in a nearly similar manner; a few drops of creosote are poured on a quantity of precipitated chalk, and the whole shaken up in a bottle of distilled water. When the chalk has settled, the clear liquid may be poured off and filtered as required for use; the preservative properties of this and also of a very diluted solution of carbolic acid closely resemble those of camphor water. For another use of carbolic acid see paper by Dr. Bastian, before quoted (Chemical News, vol. xx., p. 96.)

Alcohol diluted with water, in various proportions, is much used for the preservation of large anatomical specimens; portions of injected tissue to be viewed as opaque objects keep very well in it, also vegetable structures where loss of colour is not objectionable. The striated structure of muscular fibre is well shown when this medium is employed; a piece of cooked meat will do to experiment upon. The fibres should be well separated with the needles before the cell is closed. Many other preparations are used for the preservation of objects.

Thwaites's Fluid.—Water, 16 ozs.; alcohol, 1 oz.; creosote and chalk, as in creosote water. Pour the creosote on the chalk as before, add the alcohol, stir up the whole, and add the water very gradually; allow the mixture to stand a few days, and then filter. Dr. Beale found that this solution was liable to become thick after a time, and gives the following substitute in his "How to Work with the Microscope:"—"Creosote, 3 drachms; wood naphtha, 6 ounces; distilled water, 64 ounces; chalk, as much as may be necessary. Mix first the naphtha and creosote; then add as much prepared chalk as may be sufficient to form a smooth, thick paste; afterwards add very gradually a small quantity of the water, which must be well mixed with the other ingredients in a mortar. Add two or three small lumps of camphor, and allow the mixture to stand in a lightly-covered vessel for a fortnight or three weeks, with occasional stirring. The almost clear supernatant fluid may then be poured off and filtered if necessary; it should be kept in well corked or stoppered bottles." Dr. Beale states that he has had large preparations preserved in this fluid for more than twelve years, and that it is still bright and colourless.

Fluids are filtered by being strained through a conical bag made of a circular piece of porous paper manufactured for the purpose, folded in the usual manner, and supported in a glass or porcelain funnel of suitable dimensions. If the proper filtering paper is not at hand, white blotting paper will answer the purpose.

Chloride of Calcium (a saturated solution in camphor water.)—For making this solution, the pure fused salt should be used, and not the common kind used for drying; it should be carefully filtered before use; it can be diluted to any extent with camphor water. The saturated solution is an extremely valuable preservative fluid; it soaks into objects, rendering them transparent, but rather less so than strong glycerine; it has the advantage, also, of not injuring calcareous tissues. Insects, viz., fleas and lice, mounted whole in this medium, with little or no compression, show the tracheal system and many of

the internal organs remarkably well when properly illuminated, and are still in perfect condition; date of mounting, 1866. Flax, hemp, and other similar fibres display their structure far better in this than in any other medium, the secondary deposits being very clearly brought out.

Diluted Solution.—One part of saturated solution to ten of camphor water, answers well for the preservation of the fresh-water *Algæ*; the green colour is better preserved by it than it is in any other fluid.

Chloride of Sodium (common table salt).—A saturated solution seems to preserve *Entomostraca* very well indeed; it induces a slight degree of opacity, which is sometimes an advantage. Specimens of *Daphnia pulex* (water fleas) mounted in it in September, 1866, show much of the internal structure; the eyes and bundle of optic nerves are in very perfect condition. This solution is of value from its being readily procured anywhere, and a supply of specimens which would otherwise be lost may be preserved in it. Sea water impregnated with camphor or creosote will reserve various delicate marine animals and plants extremely well and without injury from endosmosis; by taking proper precautions they may be gradually transferred, if necessary, to strong glycerine.

Solution of arsenious acid in water has been used both alone and in combination with glycerine for the preservation of objects; the latter mixture has answered very well in re-mounting a series of injected preparations, which are now, after a period of about six years, in perfect condition. The quantity of arsenic capable of being dissolved in water is extremely small; solutions of arsenic, unless saturated with camphor, are especially liable to confervoid growths, a rather unexpected phenomenon in so poisonous a fluid.

(To be continued.)

THE CHEMISTRY OF THE BLAST FURNACE.*

By I. LOWTHIAN BELL.

My attention has just been directed to a translation of an article in your journal by Mr. C. Schinz, of Strasburg, entitled "The Chemistry of the Blast Furnace according to Mr. I. L. Bell's Experiments." In a subject, the investigation of which is attended with so many practical difficulties as this, we can scarcely hope to discover the exact truth at once, and I think I can now amend—indeed, I may say, I have in a recent paper amended—to a small extent, the views communicated to my colleagues in the Chemical Society of London, in the paper of which the article in question is a criticism. I shall at all times be glad to have my opinions freely canvassed; but in the present instance Mr. Schinz has overlooked those minor parts of the inquiry in which I have probably erred, and attacks me in language a little more forcible than is perhaps strictly necessary upon matters where I hope to show the fallacy is all on his side.

In my discourse to the Chemical Society, I expressed a dissent from the view which maps out a furnace into zones of strongly defined dimensions, and gave my reasons, one of which was the irregularity of the size of the pieces introduced into its interior. Mr. Schinz says this mode of charging a blast furnace is a mistake often committed in England. I said nothing to the contrary; I am dealing with the effect, not with the cause, and leave the practical smelter to discover whether the saving in fuel by a different mode of procedure will pay for the expense incurred in its adoption. I have stated elsewhere† that where such an expensive fuel as charcoal is employed, more care is taken in this item than with us, but observation in almost every iron-producing country in Europe enables me to challenge Mr. Schinz to name one instance where the approach to uniformity of dimensions in the materials is usually such as he would have us suppose.

The measurement of temperatures of the escaping gases of blast furnaces is assumed as being founded "upon a delusion;" because, as this gentleman observes, pieces of metals such as I employed laid on the bottom of the gas pipe, will, from their superior conducting power, not be melted by reason of their contact with the cool pipe, while ore exposed to the current of hot gases, will, from its less conducting power, acquire a temperature superior to that indicated by the non-fusion of the test metals. Now there is not one word in my paper to justify any such inference as to the mode followed in estimating the temperature of the gases; for it happens the specimens of ore operated upon in the experiments quoted were suspended by a thin rod on a tray 2 or 3 feet from the side of the gas pipe and the metals intended to denote the temperatures were placed on the same tray (6 inches square), so that all must necessarily have been equally heated. Besides, Mr. Schinz might have given me credit for more care in obtaining my data, seeing I mention the use of three different kinds of pyrometer, not one of which could, without great difficulty, have been applied in the blundering way he suggests.

But, continues this chemist, if my observations as to temperature are true, "my conclusion" is still only delusively correct, "because reduction is accelerated by proportionate quantity of gas, by the amount of carbonic oxide such gas contains, and by its temperature." Before Mr. Schinz undertook to correct me, I had published an account of experiments* undertaken to show how these three conditions affect the rapidity and extent of reduction, but neither of these phenomena is in question in the present discussion. Former experimenters had given the results of their observations as to the temperature at which reduction *begins* in a blast furnace, and I gave the grounds for respectfully dissenting from opinions entertained by such eminent men as Tunner, Ebelmen, and Scheerer.

Mr. Schinz then proceeds to pass an opinion upon Tunner's analysis of the gases of the Wrbna furnace, which he says is "decidedly wrong," and then observes that the composition given of the gas of one of the Clarence furnaces is "just as false."

I may fairly leave the reputation of my friend, Professor Tunner, as a correct observer, to stand upon its own merits, and reserve my observations for pointing out to Mr. Schinz what is really involved in his somewhat gratuitous observation respecting the analysis of the Clarence gases. I quote the results obtained as they are given in my paper:—

Volumes in 100 Volumes.	CO_2		CO		N by Difference.	
Hour of taking Sample, p.m.	1st Trial.	2nd Trial.	1st Trial.	2nd Trial.	1st Trial.	2nd Trial.
1.0	6·25	—	26·30	—	67·45	—
1.55	6·24	6·70	34·70	—	59·06	—
2.15	6·94	6·73	34·40	35·40	58·66	57·87
3.0	5·30	5·75	35·80	35·64	58·90	58·61
3.15	4·75	5·12	31·00	30·25	64·25	64·63
3.55	5·91	—	31·12	—	62·97	—
4.20	5·82	6·00	29·72	28·90	64·46	65·10
Average being	5·88	—	31·86	—	62·26	—

Now, if the above figures had been obtained by an incompetent operator, one would have expected to have found discordant results upon the repetition of the analyses, and there being no evidence whatever of this, the

* Communicated by the Author simultaneously to the CHEMICAL NEWS and *Engineering*.

† Paper on our foreign competitors in the iron trade.

* Paper read at Middlesbrough meeting of Iron and Steel Institute, September, 1869.

word "false," used by Mr. Schinz, has, to my mind, a somewhat unpleasant sound.

To its application, however, I must submit, if this gentleman is correct in his assertion that furnace gas, having a composition like that given, is "almost impossible;" for he proceeds to show how, taking the nitrogen as the basis of his calculation, the quantity of oxygen, and hence of carbon, are incompatible with the ratio in which the first two elements exist in the atmosphere, having, of course, regard to the oxygen in the ore. In the estimate which has to prove how false my data are, Mr. Schinz assumes that the sole sources of oxygen are the blast and the ore, for he never gives a thought to the *limestone*. Now this is the less excusable, seeing that in the very next page in my paper, the theoretical composition of furnace gases is compared with that furnished by analysis, and the sources of each of the constituent parts are given, among which the limestone is distinctly mentioned. I shall not trouble you with all Mr. Schinz's figures, but content myself with giving a statement, by which it will be seen how nearly the analysis agrees with what the furnace was using at the time the gases were collected for the examination, assumed by this gentleman to be so incorrect.

The consumption for each ton of iron at the time was:—

	cwts.
Coke	29·50
Limestone, calcined, and containing about 22 per cent of carbonic acid	15·50
Ironstone	49·50
The coke contained of carbon	27·14
" " ash, moisture, &c.	2·36
	29·50

The carbon which would be volatilised was:—

That contained in the coke	27·14
" " limestone partially calcined	0·93
	28·07
Less that to combine with the iron..	0·74
	27·33

The gases of which the volumetric analysis is objected to by Mr. Schinz had the following composition:—

By volume.	By weight.		
CO_2 5·88	8·94	Carbon	15·65
CO 31·86	30·82	Oxygen	24·11
N 62·26	60·24	Nitrogen	60·24
100·00	100·00		100·00

From these proportions, the gases for each ton of iron will consist, by weight, of—

	Cwts.		Carbon.	Oxygen.
Nitrogen	105·20		—	—
Carbonic oxide..	53·83	=	23·07	30·76
Carbonic acid ..	15·61	=	4·26	11·35
	174·64		27·33	42·11

Thus, then, 42·11 cwts. of oxygen are associated with the 27·33 of carbon set out with as having been volatilised. For this we have oxygen accompanying the nitrogen found

	cwts.
in the gases, which would be—105·20 × $\frac{8}{21}$	31·42
The iron in 20 cwts. of pig is 19 cwts., which, as peroxide, is equal to oxygen..	8·14
Oxygen combined with 0·93 carbon in the carbonic acid of limestone	2·48
	42·04

instead of 42·11, which will probably be accepted as a nearer approximation to truth than the words "almost impossible" would seem to convey.

The actual numbers objected to by Mr. Schinz were CO_2 6, CO 32, N 62, which was merely the volumetric composition of a mixture made for the purpose of comparing its effect in deoxidising iron ore with that of a second mixture, made to resemble the gases of the Wrbna furnace. These numbers, it will be perceived, closely resemble the analysis just examined.

This omission of limestone, as contributing to the constituents of the furnace gases, is repeated by Mr. Schinz when he examines my comparison of the gases produced by the use of hot and cold air in Wales, neither of which, it is expressly stated, were analysed, but assumed as resembling those of the Clarence Works for the sole purpose of estimating the quantity of heat carried off by their means.

In these instances, the gases were considered as consisting, by weight, of CO_2 9, CO 32, N 59; numbers which differ but slightly from those deduced from the analysis of the Clarence gases, as formerly stated.

I find I have made two errors in the calculation based on this assumption. The weight of gases from the cold blast

	CO_2.	CO.	N.	HO.	Total.
furnace should be ..	18·20	64·70	119·40	3·93	206·23
instead of, as formerly	18·19	64·73	124·60	3·93	211·45
and from the hot blast it should be	13·50	48·10	88·60	3·06	153·26
instead of, as before	12·94	46·22	92·73	3·06	154·95

The difference, however, between these two sets of figures is so small as not materially to affect the conclusions drawn from them; but Mr. Schinz arrives at a very contrary opinion by changing the weight of nitrogen, given above in the case of the cold blast furnace, from 124·6 to 142·6, and, not satisfied with this mistake, commits another in the arithmetic used in working out the result from the hot blast furnace, by which he makes the ratio of the volumes of carbon vapour and oxygen per 100 volumes of nitrogen to be 35·82 of carbon and 41·22 of oxygen instead of 29·4 and 33·8 respectively.

In alluding to my remarks on the hot blast, Mr. Schinz (*à propos* of nothing I said) mentions that, "with cold blast an increase of fuel will always yield a product richer in carbon graphite, whilst an increase of temperature by means of the hot blast will never secure the same success." All I can say is the experience of twenty-five years with blast furnaces and that gained by a constant study of a present annual make of 120,000 tons of iron has produced no such impression on my mind. Neither am I disposed to accept as a "solution of the problem relating to the wonderful effect of the hot blast," Mr. Schinz's explanation, who considers solid carbon and not carbonic oxide as the reducing agent.

If my experiments are "worthless," the calculations of Mr. Schinz are not of a very accurate order, for he founds an estimate of heat units supplied to a furnace on the assumption that 113 kilos. of carbon require 3881 kilos. of air for conversion into carbonic oxide, whereas it ought to be 655 kilos. and equally so is his calculation which proves hot blast iron to require more fuel than that smelted with cold air.

I am censured, too, for not being able to distinguish between height and capacity in referring to the economy in fuel effected by a change in the dimensions of blast furnaces. My language may be defective in clearness, but it seemed to me that when I stated that the Lilleshall furnaces saved coal by an addition of 21 ft. to their height, none but a very fastidious critic could have imagined this alteration in form to have been made without their capacity having been increased to a corresponding extent.

There is little in Mr. Schinz's review of my work I am disposed to assent to, but I am unwilling to trespass further on your space, which I have been induced to do at some length in order that the Fellows of the Chemical Society, who honoured me by an invitation to give an address on applied chemistry, should not think I had complied with their request in the negligent manner this gentleman would have them believe.

Washington, Durham.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 4th, 1869.

Sir Benjamin C. Brodie, Bart., F.R.S., in the Chair.

The minutes of the previous meeting having been read and confirmed, the following certificates were read:—

For the first time—Sir Roderick Impey Murchison, Bart., Belgrave Square; John Wiggin, Pharmaceutical and Analytical Chemist, Ipswich; George Harrison, Analytical Chemist, 26, Havelock Square, Sheffield; Thomas Walton, M.R.C.S., and L.S.A., Lecturer on Chemistry at the Hull and East Riding School of Medicine, Kingston-upon-Hull; Edward Smith, Practical and Pharmaceutical Chemist, Strand, Torquay; G. Manley Hopwood, 22, Grosvenor Square, All Saints, Manchester; Thomas Gibb, A.R.S.M., Engineer; Matthew H. Cochrane, 108, Paul Terrace, Glasgow.

For the second time—E. S. Blackwell, Analytical and Consulting Chemist, 6, St. Sacrament Street, Montreal, Canada.

For the third time—Alfred Dudley Keightley, Gatcheck Gunpowder Mills, Old Hall, Milnthorpe, Westmoreland; W. Fletcher Barrett, Lecturer on Physical Science at the London International College; John Morrison, Analytical Chemist, County Wicklow, Ireland; Temple A. Orme, Teacher of Chemistry and Experimental Physics in University College School; W. G. Lewis, Fellow of Oriel College, Oxford.

The last-named gentlemen were ballotted for and duly elected. Mr. Gerstl was elected an Associate of the Society.

The Chairman said the first business before the Society was to consider a paper "*On the Atomic Theory*," which had already been read before the Society by Professor Williamson. This theory was not to be regarded as a fixed and definite system of ideas, but one that had undergone great variation and change. There was the atomic theory of Dalton; then that of Berzelius, and also, in a certain sense, that of Laurent and Gerhardt; and now they had come to a further form of this theory, in which new ideas had arisen in regard to the nature of atoms and their properties; and he (the Chairman) thought it would greatly facilitate the discussion if Dr. Williamson would explain what was the precise form of the atomic theory which he was prepared to maintain and defend, and how they might discriminate that from other forms of the theory which were neither reasonable, nor rational. First, there was the question whether there were atoms at all; then, being atoms, what those atoms were, and whether they were endowed with the properties assigned to them in regard to their replacing power, and to what was termed, their value.

Professor Williamson, on rising, said that he did not admit that, among chemists, there had been several atomic theories. If there had been, he had yet to learn of them. There had prevailed, he believed, from time immemorial, a belief that matter was built up of small particles; and he might also say that no contrary opinion had ever been embodied in any definite form. Dalton doubtless looked for evidences of what he believed to be true, and saw, in the simple multiple proportions which he specially alluded to, facts which were in accordance with that preconceived conviction; but his was the mere germ of an atomic theory, and the changes which have taken place in it since are consistent with the original notions. The very rapid changes had, in the main, been additions to the starting-point given by Dalton. The line of work so vigorously pursued of late years by many chemists, regarding the order in which atoms are arranged in their compounds, was mentioned by the speaker, His endeavour had been to put together more fully than had been done of late what is known of the chemical evidence; firstly, respecting the limits to the divisibility of matter, and, secondly, with regard to the properties of those finite particles which constitute the limits of divisibility, solely from the point of view habitually employed by chemists in their ordinary working. He had also endeavoured to separate those conclusions which appeared to him warranted by facts from everything else. Whether the smallest particles of matter had a spherical form or not, whether they were in their nature indivisible, whether they were in reality the ultimate atoms of matter, or like the planets of this system, he knew not, nor did such questions exist for him as a chemist. He therefore thought it wise to exclude them, important as they were, from the actually existing atomic theory. The work of Berzelius was perhaps the most significant transition from the original notion of Dalton. Silently these atoms had been accepted by chemists, and the whole course of investigation had been one grand confirmation of the assumption that compounds must have molecular weights corresponding to at least the smallest atomic proportion which would represent the actual numbers of analysis. The perfectly independent observations which had been made in reference to: the boiling points of homologous liquids, the phenomena of diffusion, the equality of volumes of masses containing an equal number of these molecules under similar conditions in the gaseous state, all concurred to corroborate the conclusions necessitated by the atomic theory. Thus, independent workmen hewed stones which, when hewn, were found to fit in exactly with the others, forming a perfectly homogeneous whole. Dr. Williamson concluded his remarks by referring to the atomic values, a term which, he thought, represented in a more precise way than some others what is called atomicity; and he also referred to the difference between direct and indirect combination, a fact which he conceived to be essentially atomic in its nature.

Dr. Frankland was not present when Professor Williamson delivered his lecture, and he had only cursorily looked over the printed memoir; but, so far as he could gather, the object of the author had been to establish the atomic theory as an absolute truth. There had been, he thought, so little, if any, opposition to the application of the atomic theory to the phenomena of chemistry, that a discussion could scarcely be raised upon any other feature of the question than that of its absoluteness. He considered it impossible to get at the truth, as to whether matter was composed of small and indivisible particles, or whether it was continuous—the question belonged to what metaphysicians termed "the unknowable;" but he acknowledged the importance of the fullest use of the theory as a kind of ladder to elevate the chemist from one position to another in his science. He was, however, averse to accepting the theory as an absolute truth. Any attempt to realise by its help the action of attractive or repulsive forces upon matter was excessively difficult, indeed to realise such an action through a perfectly void space was to him quite impossible. The same difficulty presented itself to Faraday, who was often obliged to throw on one side, as an obstacle to his progress, this atomic theory. He said that if matter be assumed to be thus composed of solid particles separated by a void space, then, in considering the phenomena of electricity in connection with that view of matter, this space existing between the atoms must be either a conductor, or a non-conductor of electricity. If a conductor, such a thing as an insulator was obviously an impossibility; if it was a non-conductor, such a thing as a conductor was equally inconceivable; so that, apart from chemistry, there were considerations which made it very undesirable for this theory to be represented as an absolute truth. The speaker then referred to the combination which, in certain cases, is effected between gases by the application of heat,

and said that, according to the atomic hypothesis, they must assume that the gases, when heated, have their particles driven further asunder; but how, then, could they more readily enter into combination when heated, as was the case with oxygen and hydrogen, and in many other similar instances? No such difficulty presented itself if the gases were regarded as continuous matter. He admired the theory as much as Professor Williamson, and he thought no one could blame him for not making a sufficient use of it; but he did not wish to be considered a blind believer in the theory, or as unwilling to renounce it if anything better presented itself to assist him in his work.

Dr. Odling, as a chemist, was not particularly interested in the question whether matter was infinitely divisible or not, but he did not think that Dr. Williamson's argument had established that conclusion. Dalton was always spoken of as the discoverer of the law, or doctrine, or theory of combination in definite and multiple proportions, to account for which his invention or adoption of the atomic theory was founded; and he conceived Dalton's great discovery to be better expressed as the law of combination in *reciprocal* and multiple, instead of in *definite* and multiple, proportions. Dr. Williamson had said of chemists that all their modes of thought, and all the government of their actions, was based upon the atomic theory; but he (Dr. Odling) maintained that it was based upon the observed fact that certain bodies combined in certain proportions. Dr. Williamson also argued that the atomic theory was based upon the existence of molecules, and that molecules had no *locus standi* in the absence of the atomic theory. He (Dr. Odling) disputed that position, for the fact that the hydrogen existing in marsh gas was divisible into four parts, and the hydrogen existing in ammonia only into three parts, was, he conceived, a fact quite independent of the atomic theory. The laws of combination, as far as they go, were compared by Sir Humphry Davy to Kepler's laws of planetary motion, which were simply a general expression of observed facts; and, in the same way, these laws of chemical combination were general expressions of observed facts upon which the atomic hypothesis was super-induced.

Professor Miller thought that Dr. Odling's arguments had not disproved the atomic theory; if they had not the atomic hypothesis, they were entitled to ask what explanation they possessed of the laws of combination? Certain facts were admitted on all hands, as determined by experiment, and when an important and extensive series of facts was ascertained, the endeavour to explain them by some supposition which embraced the facts, and which enabled them to anticipate new ones if possible, was a necessary result of their mental constitution. Unless some hypothesis were accepted, it was absolutely impossible to reason upon the facts; and if they could not adopt this hypothesis as absolutely true, such a view of the constitution of matter explained all the chemical facts that had hitherto been presented. It appeared to him that those who denied the atomic hypothesis were bound to supply something to enable them to interpret phenomena with the same regularity and order as the hypothesis, the accuracy of which they denied and desired to displace. No one would suppose that the absence of an undulatory theory for light would conduce to the explanation of optical science; and he held that what the undulatory theory was to the phenomena of light, the atomic theory was to the phenomena of chemistry.

Professor Foster thought the question before them was not so much the utility of the atomic theory as its truth. M. Naumann had stated, in his "Relations of Heat to Chemistry," that, if we assumed that in any compound body the components really occupied distinct portions of space, they must assume that body to be incapable of infinite divisibility. He thought the ideas generally entertained of the existence of the constituents of bodies in compounds were not absolutely necessary ideas. The fundamental phenomena of chemical changes might sometimes be explained by returning to the notion of the actual mutability of matter. By operating upon one portion of matter, it was actually transmuted into another, a qualitative and quantitative relation existing between the disappearing and the appearing bodies. From such ideas as these, they could not deduce the necessary existence of atoms; but all our present modes of expression and modes of thought were founded upon an atomic hypothesis or basis.

Professor Tyndall sympathised with the ideas of Professor Williamson; his thoughts had, to some extent, been expressed by Dr. Miller, who had made a strong point in referring to the undulatory theory. That theory was something super-induced upon the facts, which might be readily detached from the theory. But it was in the nature of the human mind, it was in the nature of a profound thinker, when pondering upon facts of this nature, to seek for some underlying principle outside the region of facts, from which the facts followed as consequences. Dr. Odling ought to have gone a step further than Kepler; for something that we now call "the theory of gravitation" was certainly super-induced upon his facts, as the atomic theory is upon the facts of multiple proportions. Professor Foster had justly referred to the consideration that a bad theory was very often useful. The emission theory of light was useful in the hands of Newton, Laplace, Malus, and Brewster; but this theory fell, because, in the progress of investigation, facts arose which were inexplicable by it, and which were completely explained by the undulatory theory. The undulatory theory would successfully front all opposition as long as it was competent to explain the facts of optics; and he apprehended that the atomic theory would stand as long as it was competent to explain the facts of chemistry.

Dr. Mills's conviction was that chemistry had no facts to support the notion of a limit, and the undulatory theory had an immense advantage over the atomic theory, for the existence of waves was a fact, while the existence of a limit was not a fact. It seemed to be forgotten by many writers that matter might be infinitely divisible, and yet that definite proportions might exist, for between two infinites there might be a finite ratio, so that the atomic theory was not perfectly necessary to chemistry. He believed that motion was the highest generalisation of modern science, and it therefore afforded the only criterion by which all theories, including those of chemistry, must be judged, and the notion of a limit was practically inconsistent with the idea of a motion.

Dr. Williamson, in his reply, remarked that the benefit accruing from looking at the question from another point of view would be incalculable, and if another view was developed to supersede the present one, he would be among the first to rejoice at it, but he had not to do with the future of this matter. He had endeavoured to put together the actual evidence of the present view, and none of its opponents had been able to find a fallacy in that evidence. He thought it most important to keep the theory at each period of its growth in the modest position which it at present occupies, that of generalising the best-ascertained relations of the elements in their chemical changes.

The Chairman liked to have clear and definite ideas, as far as he was able to realise them, on scientific subjects, and he was unable to consider even an atomic theory in the abstract. The atomic theory, as he understood, was —that matter is made up of finite particles, the aggregate of which could be divided and subdivided until at last only one particle would remain, and this view might be derived from the perusal and common assent of every work on Chemistry that defined the atomic theory. He thought that such a view as the physical indivisibility of matter must be separated from the facts and basis of chemistry. Dr. Williamson seemed to think the theory and facts were one, but he (the Chairman) asserted that they were two distinct things. He must also express his dissent from the views expressed by Drs. Frankland and

Miller, with reference to the use of a doctrine or theory in which they did not believe. He could not understand using a theory and denying it at the same time. This theory had, he thought, been often the means of deluding chemists into the belief that they understood things about which they knew nothing. He found the works of Kekulé and Naquèt scribbled over with pictures of molecules and atoms, combined together in all imaginable ways, for which he thought there was no adequate reason, and if there was no reason it was a mischievous thing to do. Many students, he believed, thought the pictures in Naquèt's work were chemistry; they did not draw the distinction between the facts and theory of science. His view was that the ultimate constitution of this material universe was one of those things upon which no light had yet been thrown, and he agreed with Dr. Odling when he said that the science of chemistry did not require or prove the atomic theory. They were bound to have some real and adequate means of working at the science of chemistry, and discovering its laws, and they could effect this either through the investigation of the laws of gaseous combination or the study of the capacity of bodies for heat. When they approached the science through the study of gaseous combinations, they discovered that the combining proportions of bodies were capable of being represented by integral numbers, and they also found an analogous fact in studying the capacity of bodies for heat.

The meeting was then adjourned to November 18th.

NOTICES OF BOOKS.

Nature: "*A Weekly Illustrated Journal of Science.*" MACMILLAN and Co., London.

WE are glad to notice the birth of a new popular journal of science. It was never more wanted than now, for it is undeniable that at no previous period has there been such a manifest desire on the part of the general public to understand somewhat of the great scientific discoveries and generalisations which are perpetually springing up around us. Among the objects proposed to be attained by "Nature," is the urging "the claims of science to a more general recognition in education and daily life," and we are fain to believe that there is now amongst us such a movement in this direction, emanating from diverse sources, that the time is not far distant when science will form as much a part of our own educational system as it does of that of other countries.

"Nature" appropriately opens with a series of aphorisms by Goethe; a semi-poetic composition, formed as it were, halfway between prose and poetry, in which an exalted form of prose almost merges into a regular rhythmus. Of Nature Goethe says:—"She tosses her creatures out of nothingness, and tells them not whence they came, nor whither they go. It is their business to run, she knows the road. . . . . Her crown is love. Through love alone dare we come near her. She separates all existences, and all tend to intermingle. She has isolated all things in order that all may approach one another. . . She is complete but never finished. As she works now, so can she always work. Everyone sees her in his own fashion. She hides under a thousand names and phrases and is always the same."

The principal papers are "On the recent total eclipse of the Sun" by J. Norman Lockyer, and "On the fertilisation of Winter Flowering Plants" by A. W. Bennett. There is a review of Madsen's *Antiquités Préhistorique du Danemarck*, by Sir John Lubbock, and of Newman's "British Moths," by W. S. Dallas, and other shorter notices. A paper (read at the last meeting of the British Association for the Advancement of Science), by the Rev. W. Tuckwell "On Science-teaching in Schools" contains a number of very useful suggestions, and will be read by science masters with interest. Professor Williamson furnishes an interesting life of the late Professor Graham, and we wish we could commend the accompanying portrait to a like extent. Mr. Geikie, gives an account of the meeting of German naturalists at Innsbruck. Among other features of the Journal we find several columns of "Notes," containing a chit-chat account of the matters most discussed in scientific circles at the present time. Finally, there is a *resumé* of recent work in all the more prominent branches of science, and of the proceedings of Societies and Academies. We wish "Nature" every success; it is well supervised, its contributors are manifold, and it is issued by an eminent firm of publishers. It will be a healthy sign of the times and of progress, when every educated man reads a scientific journal as regularly as he reads his "Saturday" or "Pall-mall," and to such a result the issue of "Nature" conduces.

MISCELLANEOUS.

University of London.—The following are lists of the candidates who have passed the Second B.Sc. Examination:—*Pass Examination.*—First Division. William Henry Johnson, University College; Alexander Muirhead, University College; William Stephen Ridewood, B.A., private study. Second Division. Phineas Simon Abraham, Trinity College and Royal College of Science, Dublin; William Barnett Burn (First M.B.), St. Bartholomew's Hospital; Dan Isaac Davies, private study; Septimus Peché Moore, LL.B., New and University Colleges; Frederic James Montague Page, Royal School of Mines; Frederick Antony Potter, Royal School of Mines; Charles Thomas Whitmell, St. John's and Trinity Colleges, Cambridge; William Henry Willans, University College and Royal School of Mines.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, November 2, 1869.

This number contains the following original papers and memoirs:—

Industrial Use of Mineral Oils for the Purpose of Heating Steam Boilers, and particularly Locomotive Engines.—MM. St. Claire-Deville and Dieudonné.—This paper gives an interesting account of a series of experiments made by the authors with locomotives upon the French Eastern Line (Paris to Strasbourg), with a speed of 46 kilometres (about 29 miles) per hour, and upon a portion of the line of railway which is by no means level. The consumption of mineral oil was from 3·44 to 5 kilos. per kilometre, over a total distance of 142 kilometres, run over with heavily-laden trains. The authors state that the combustion was very complete.

Heating of Wines.—M. Thenard.—This subject, which has been repeatedly before the meeting, seems to have given rise to some jealousy, as well as captious controversy. The author of this paper, acting upon the principle "*Qui bene distinguit bene docit*," states that M. Appert first discovered the principle, that M. Pasteur has given a proper scientific explanation thereof, and that, lastly, M. Vergnette has been the first man who has industrially applied this principle on the large scale with good success.

Asia Minor.—M. Tchihatcheff.—This author presents to the Academy the last, that is the eighth, volume of his great work concerning a hitherto very imperfectly known part of the globe. This volume comprises the physical geography, climatology, botany, and geology of the above-named country. The author's work is highly eulogised, and is a very valuable contribution to science.

The Chalk of Northern Europe.—M. Hébert.—A lengthy paper on an important geological formation which the author distinguishes according to the presence or absence of some animal remains into groups of different ages.

Chemical Researches of Various Combustible Gases Naturally Occurring in Central Italy.—MM. Fouqué and Gorceix.—The authors have investigated twenty-eight different kinds of gas, collected chiefly in the Appenine mountains between Modena and Imola, including four different kinds collected at the Lagoni, which yield boracic acid. As instances of the composition of these gases, we quote:—Barigazzo—CO_2, 1·58; N, 1·81; C_2H_4, 96·61. Sassuno—CO_2, 1·14; N, 0·39; C_2H_4, 80·60; C_4H_8, 17·87. Gases from the Lagoni:—Larderello—HS, 4·20; CO_2, 90·47; N, 1·90; H, 1·43; C_2H_4, 2·00. Serrazzano—HS, 6·10; CO_2, 87·90; N, 2·93; H, 2·10; C_2H_4, 0·97. This lengthy paper contains a very interesting account of the localities where the gases have been collected, and is a valuable addition to chemical geology.

A Measure which is Not Effected by Change of Temperature.—M. Soleil.—This author proposes (*risum teneatis amici*) to use beryl, the precious stone, as a suitable material for the construction of a standard measure of length, on account of its exhibiting peculiar properties on being submitted to changes of temperature, whereby it is possible that, under certain condition, it will remain invariable. Unfortunately, there are no beryls found of a metre in length, and, therefore, only a centimetre standard could be made.

Constitution and Motion of Glaciers.—MM. Grad and Dupré.—The chief results of the labours of these authors are the following:—The crystals of ice of the glaciers are arranged in a regular manner, and the constituent molecules of that ice are placed as in frozen water. The velocity of motion of a glacier increases from the bottom to the top, while the maximum of motion coincides with the greatest slope.

Heat Reflected from the Moon's Surface.—M. Baille.—According to this author, the moon's surface emits as much heat as a cube filled with boiling water, covered with lamp-black, having a surface of 6·5 square centims., and placed at a distance of 35 metres from the thermo-electric measuring apparatus employed by the author for his experiments.

Synthesis of Guanidine.—M. Bouchardat.—Four volumes of ammonia gas, and one volume of chloroxycarbonic acid, act upon each other with energy, producing chloride of ammonium and urea—

$$C_2O_2Cl_2+4NH_3=C_2H_4N_2O_2+2(NH_4Cl).$$

On repeating this experiment, the author also obtained urea, but, simultaneously, divers carbonic acid amides, and especially, also, guanidine. The author has operated with large quantities, no less than 150 litres, of chloroxycarbonic acid at the same time, and has obtained thereby:—(1) Guanidine, the sulphate of which corresponds, in composition, to the formula $S_2O_8(C_2H_5N_3)H_2O_2$. (2) Urea. (3) Melanuric acid, a white-coloured substance, insoluble in water, soluble in weak aqueous solution of caustic potassa, nitric, and hydrochloric acids; formula, $C_6H_4N_4O_4$. (4) Cyanuric acid.

On Chloral.—M. Bouchat.—During the discussion which followed the reading of this paper, it was incidentally mentioned that M. Personne, director of the chemical laboratory of the Ecole de Pharmacie, Paris, had instituted a series of experiments with chloral upon animals, with the result that chloroform was readily detected in various fluids of their bodies, after the administration of chloral.

Anti-Cholera Tissue.—M. Adeline.—This author, or rather manufacturer, having learnt that, from the experiments and experience of Dr. Burq, copper is a certain antidote against Asiatic cholera, presents samples of various woven fabrics, wherein a certain quantity of copper wire is introduced for the purpose of serving as prophylactic.

Phosphorescence of the Sea.—M. Duchemin.—According to this author, that phenomenon is due to electricity, and the infusoria only act as sharp points do in well-known electrical experiments.

Useful Application of Arsenious Acid.—Dr. Lisle.—If the statements of this physician are confirmed, arsenious acid will become a great boon to a large number of people afflicted with that most dire disease, mental derangement. According to this author, arsenious acid, properly administered, even in apparently hopeless cases, restores about 66 per cent of the afflicted to health.

Cosmos, October 30, 1869.

From this number we abstract:—

Extraction of Benzol from Coal-Gas.—M. Meunier.—All coal-gas contains the vapour of benzol, in more or less quantity. By means of cooling mixtures, pressure, and the use of some chemical reagents, as, for instance, strong nitric and sulphuric acids, chlorine, and bromine, benzol may be withdrawn, more or less completely, from coal-gas; it appears, however, that the following simple and effective plan suggested by the author, answers the purpose far better, since it is by a simple application of a solvent that the benzol is obtained:—The gas is made to pass slowly through coal oils (liquid hydrocarbons), the boiling point of which is higher than that of benzol; but it has been ascertained that petroleum, paraffin oils, schist oils, and even fixed fatty oils, will answer this purpose equally well. After a time, these fluids become saturated with benzol, and the latter is obtained by fractional distillation. It should be borne in mind, however, that gas thus deprived of benzol and its homologues loses a great deal of its illuminating power, even so much, in some instances, as to be only fit for heating purposes.

Saccharimetrical Congress at Berlin.—There has just been held at Berlin, under the presidency of the well-known Dr. Scheibler, a meeting of some twenty-five chemists, whose chief occupation is the investigation and analysis of raw sugars. The aim of these gentlemen, to fix upon a uniform method for all quantitative estimations of sugar, and thus to insure good and conformable results, has been accomplished. Special committees have been appointed to investigate everything relating to the optical saccharimetry; one of these committees undertakes to investigate thoroughly the optical power of different thin plates of quartz in reference to pure sugar; another committee, again, is engaged in the preparation of a standard sample of pure sugar, and superintending the manufacture of perfect and uniform optical saccharometers to serve as standards. A central laboratory is to be established, with branch establishments at various localities in Germany.

Temperature of the Human Body.—The average maximum temperature of adults above twenty-five years is 37·25°; below that age, 37·1°. The temperature of the human body is subject to diurnal variation—from 6 p.m. until midnight, the temperature decreases, and increases again from 3 a.m. until 9 a.m.; this variation is, on an average, 0·49°. A thermometer placed under the tongue indicates about 40°.

Guano from the Chincha Islands.—According to what the editor of *Cosmos* states to be reliable information, the quantity of Peruvian guano is so rapidly decreasing that it is no longer difficult to calculate beforehand the period at which there will be no more forthcoming. The deposit of the Guanope islets, which is, however, of inferior quality, will last for some ten years to come. After that period the Lobo Islets may yield some of this manure; but it has been ascertained that the deposit there found is relatively very poor in ammoniacal salts, and contains, moreover, very much sand.

Vulcanised Caoutchouc.—M. Mouton.—In order to give to vulcanised caoutchouc all that softness which is requisite, for instance, for printing-ink rollers, the author reduces ordinary vulcanised caoutchouc to powder, places it in suitably-shaped vessels, and submits it a second time to the temperature required for vulcanisation. By this means it is rendered soft and smooth, has entirely lost its usual harshness, and is fit for various uses—among these the making of durable printing-ink rollers.

November 6, 1869.

This number contains the following original papers:—

Description of an Oven for Burning Pottery and other Ceramic Pastes.—M. Hofmann. The contrivance here alluded to is an improvement upon those hitherto in use, which cannot be continuously used, but are only worked by interrupted periods. The furnace, or oven, here described is, in exterior appearance, somewhat like a large lime-kiln; but its interior construction consists of compartments, separated by double walls made of fire-bricks. The consumption of fuel of these ovens is stated to be small. With a circumference of 120 metres, each compartment of the contrivance alluded to is capable of containing 10,500 bricks; and about 4½ millions of bricks can be annually fired by this oven, with a saving of from 50 to 60 per cent of fuel as compared with the old methods.

Preservation of Telegraph Poles.—M. Delarge.—The preservation of the large number of wooden poles in use for carrying the conducting wires has become a very important subject. The author reviews the use of the following substances employed for the purpose:—*Sulphate of copper.*—On inspection of a large number of poles treated with this substance, it was found that, notwithstanding nearly twenty years' service, the wood was in a very excellent state of preservation; but it should be added that very much depends upon the kind of timber used for the purpose, and upon the period of the year when it is cut down. *Creosote* is very extensively applied, and, according to a series of comparative experiments, purposely instituted in Belgium, during the years 1861 and 1862, the durability of creosoted timber is considered equal to that treated with sulphate of copper. Creosote, however, is found to be, in many instances, very inconvenient, both on account of the odour it emits, and on account of the injury caused by its corrosive action upon the hands of the workmen. *Chloride of zinc.*—According to the experience of the Netherlands officers of the Waterstaat, to whom is confided the *matériel* of the telegraphic lines of that kingdom, the use of chloride of zinc has given great satisfaction in the sandy soils of Gelderland; whereas in more calcareous soils, chloride of zinc did not answer the purpose at all, a result also observed in Germany. According to the author, there is a good deal of practical experience yet to be gained in this department of chemical engineering, since every day more and more proves that the nature and qualities of the soil wherein the poles and other timber, railway sleepers, &c., are placed has a vast deal more to do with the preservation of the wood than could be, *à priori*, conjectured.

Annales des Mines, Nos. 3 and 4, 1869.

These two numbers have been issued together, and contain the following original memoirs and papers:—

Mineralogical Tabulated Form.—M. Adam.—This is a concise, but very complete and highly useful, review of the minerals, properly classified in forty-two sections, beginning with hydrogenides, and appendix on meteorites. The table indicates the crystalline shape

hardness, specific gravity, fusibility, and solubility of the various minerals, and contains, moreover, tables of equivalents of the elements and oxidised substances, with the symbols and the quantity of oxygen contained in 100 parts. We, moreover, meet here with a new method for the calculation of the relations of the elementary bodies in any analysis; this may be best explained by quoting the following:—Take, for instance, sulphur, antimony, and silver; the equivalents thereof (O=100) are—S, 200·00; Sb, 1583·00; Ag, 1350·00.

Equivalent of sulphur, $\frac{1{,}000{,}000{,}000}{200} = 50{\cdot}0000$

" antimony, $\frac{1{,}000{,}000{,}000}{1{\cdot}325} = 6{\cdot}5573$

" silver, $\frac{1{,}000{,}000{,}000}{1{\cdot}350} = 7{\cdot}4075$

A table being thus made for all elementary bodies, the multiplication by the quotients obtained, of the quantities found by weight as result of the analysis, replaces the division of these same quantities by their equivalents, and yields the same relation; for instance—

Analysis of Miargyrite.

			Rapport, or relation.
Sulphur	21·77 × 50·0000 =	108·850	4
Antimony	41·49 × 6·5573 =	27·206	1
Silver	36·74 × 7·4075 =	27·214	1
	100·00		

The division by the equivalents would have given—

$$\text{Sulphur, } \frac{21{\cdot}77}{200} = 108{\cdot}850,$$

and so on for the other elements. This memoir is a most valuable addition to mineralogy, as well as to the chemistry of minerals.

On Smoke-Coloured Quartz.—M. Commanges-Guitaud.—This paper, a letter from the French Minister, resident at Berne, contains full particulars concerning the discovery and the exploration of quartz of rare beauty, accidentally discovered in the Tiefengletscher of the valley of Urseren, Canton Uri, Switzerland. We have before had an opportunity of quoting this subject.

Use of Sewage Water in Agriculture, according to Experiments and Observations made Abroad and in France.—M. Freycinet.—This extensive memoir, filling some 130 pages, is not suitable for abstraction, but deserves the notice of all parties interested in this subject.

Mineral Resources of Algeria.—M. Ville.—This is a complete treatise on the mineral resources of Algeria, treating of the mineral fuel; iron ores; ores of copper, lead, and zinc; ores of antimony and mercury; the metallurgical works; the salt springs, salines, and deposits of rock-salt; deposits of saltpetre; quarries or layers of gypsum and alabaster; lime-stones; building-stones; brick-clay; clay fit for making pottery; slates; pouzzolanes (natural cements); sand fit for industrial use; mineral and thermal springs, divided into four groups, according to their chemical composition; and, lastly, on the success which has attended the boring for water in Algeria. This paper is an excellent monograph, and it would be highly useful if so complete a review of the mineral wealth of every European country were published.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 142, 1869.

This number contains no original papers relating to chemistry or allied sciences.

Moniteur Scientifique, November 1, 1869.

This number contains the following original communications:—

On So-called Iodine Green.—M. Peters.—The author of this paper states that he has thoroughly investigated this subject, and has overcome the difficulties especially attending the dyeing of wool with the green dye, now rather inaptly called iodine green. The author points out that the following advantages are obtained by his method:—(1) Woollen and mixed tissues can be dyed in a short space of time with very pure shades; (2) the colouring material is not wasted, but entirely exhausted; (3) the expense does not exceed that of the use of the so-called aldehyde green, but the iodine green is purer and faster, while shades of green, either verging upon yellow or blue, can be obtained which are not affected by artificial light. The process of dyeing is described as follows:—Impregnation bath (*bain d'impregnation*)—for bluish green, 25 kilos. of liquid iodine green, for dyeing wool, and 75 kilos. of water; for yellowish green, add 22·5 grms. of crystallised picric acid. When this mixture is brought to the boiling heat, there is placed in it a quantity of previously well washed wool which has been treated with sumac. The wool is left in the bath for about half an hour, and, on being removed, the excess of fluid is got rid of by wringing or, better yet, by the centrifugal machine. The liquid thus obtained still contains a sufficient quantity of colouring matter to be used again. The green-producing bath (*bain producteur du vert*) consists of—Water, 100 kilos.; strong sulphuric acid, 250 grms.; liquid bichloride of tin, 125 grms. This bath is used at a more or less elevated temperature, which depends, in great measure, upon the strength and quality of the tissues or yarn to be immersed therein. Instead of the liquid iodine green above alluded to, and which is not well suited for transport, the author states that, of the iodine-green paste, as met with in the trade, 10 parts have to be mixed with 200 of water; the addition of picric acid may be neglected, and, instead thereof, a small quantity of sulphuric or acetic acid should be added. Fifty parts of the fluid so obtained should be mixed with 150 parts of water; ammonia should be added, and the liquid filtered; after which it is only applicable as an impregnation bath, as above alluded to.

Prophylactic Properties of Phenic Acid.—M. Schiffmann.—The author writes from Valle-Menier, Nicaragua, Central America, stating that, after a very severe epidemic of Asiatic cholera, which caused, during fifteen months, the death of a large number of people, he commenced the use of phenic acid (carbolic acid), causing all the rooms and passages of his house and gardens to be daily watered with water to every pailful of which a tumblerful of the aforesaid acid had been added. The same plan was adopted in the cottages and gardens occupied by about three hundred people, with the result that not only no more was heard of the cholera, but there was also a cessation of intermittent fever (ague), which had almost continually pestered that locality. The author adds that he observed the extermination of all vermin, and that he also used the acid in agriculture, in order to kill noxious insects, especially ants, which abound in that clime, and do great injury to cacao trees (*Theobroma cacao*). Mixed with paint, the author applies phenic acid to wood-work, which is thus preserved from the attacks of white ants and similar vermin.

On Soaps and the Chemical Analysis thereof.—M. Joffroy.—Several methods have been at various times proposed for the quantitative estimation of the various constituents of soap. The following methods are quoted here:—50 grms. of the soap are cut up into thin shavings, and dried in a water-bath until no more loss is experienced on subsequent weighing. 12·5 grms. of the soap, cut into thin shavings, are exposed to the action of the air, in order that the free alkali present may thereby become converted into an alkaline carbonate. The sample is next dried, and afterwards dissolved in strong alcohol. In the residue insoluble therein will be found—(*a*) By means of the balance, the total quantity of free alkali (as carbonate) and other salts; (*b*) by means of neutralisation with a test-acid, the quantity of free alkalies; (*c*) by subtracting the quantity of the latter, the quantity of foreign salts will be obtained—that is to say, chlorides, sulphates, &c., of soda, potassa, and other bases. The alcoholic solution is evaporated to the consistency of a syrup, mixed with water, and decomposed by means of hydrochloric acid, whereby the fatty acids are obtained. These, after having been well washed with distilled water, are dried in a water-bath, and weighed. The aqueous solution from which the fatty acids have been separated is evaporated to dryness, ignited, and the residue weighed. This residue is chloride of sodium in the case of hard or soda soap, and, from the quantity obtained, the soda is calculated. In order to estimate the free fat, that is to say, the fat non-combined with an alkali, 10 grms. of the soap are decomposed with hydrochloric acid; the fatty matter is saponified by means of baryta, and the baryta soap obtained is treated with alcohol, whereby the unsaponified fatty matter only is dissolved. The nature of the fatty acids contained in the soap may be ascertained—that is to say, we may find whether stearic, margaric, or oleic acids predominate—by dissolving 5 grms. of the soap in water, adding to the solution enough sulphuric acid to decompose the soap, and the estimating, by means of a very sensitive thermometer, the melting point of the fatty acids; but it should be borne in mind that this operation only gives an approximate result. Another method of testing soap is the following:—Take 1 grm. of the soap, place it in a suitable vessel (a beaker glass), add ether to it, and next acetic acid in a somewhat smaller quantity. The liquid will separate, after a while, into two distinct layers, the upper of which contains in solution the fatty acids, while the lower layer contains the alkalies, and salts, and such substances as might happen to be insoluble in the two fluids just named. By means of a pipette, the fluids are separated from each other. The ethereal solution is poured into a previously weighed beaker glass, and the ether evaporated upon a water-bath, and next again weighed with the fatty acids it contains. The aqueous acetic acid fluid is evaporated to dryness, and the quantity of alkali determined according to well-known methods.

Revue Hebdomadaire de Chimie, November 4, 1869.

This number contains the following original papers:—

Apparatus for Distillation and Concentrating Liquids in Vacuo.—M. Mène.—When a closed vessel filled with steam is suddenly and efficiently cooled, this vapour is condensed, and there is produced inside that vessel a perfect vacuum, saving always the tension of the water vapour at the temperature to which it is cooled down. It is according to this principle that an apparatus has been constructed, which is illustrated by woodcuts, which are essentially necessary to the proper elucidation of the mode of action and arrangement, which is, however, so contrived as to admit of continuous action. The apparatus is made of copper, tinned inside, and is applied with great success to the extraction of the aroma of such plants and parts thereof as cannot, without deterioration of the peculiar fragrancy of the same, be submitted to the ordinary distillation process.

Tubular Germinating Machine for Malt Making.—M. Puvrez-Bourgeois.—The author begins by explaining that preliminary process of beer brewing called malting, which is generally known, although some erroneous opinions are in circulation on this subject. Grain does not, in its healthy and fully ripe state, contain any sugar at all. The process of malting is so conducted that, after the grain has been steeped in water for some hours, and has thereby become quite soft, it is placed on what are technically termed beds, and these kept together in a locality which should not be colder than from 14° to 18°. While spread out on these beds, the grain begins to germinate just as if it were sowed in soil, the radicule makes its appearance. It is necessary,

however, to supply to the grain under operation air in sufficient quantity; and, on that account, the grain has to be turned over by means of shovels. The apparatus devised by the author, and illustrated by woodcuts, is constructed with the view of receiving the grain after it has been steeped: it is put in tubes, which are closed by means of perforated lids, and can be moved by means of machinery. According to experience obtained with this apparatus on the large scale, it is highly satisfactory. The author adds one of the most recent analyses of barley, and of malt obtained therefrom. 100 parts, in dry state, contain, for barley—Dextrine, 5·6; starch, 67·0; sugar, 0; cellulose, 9·6; albumenoid substances, 12·1; fatty matter, 2·6; ash, 3·1. For malt—Dextrine, 8·0; starch, 58·1; sugar, 0·5; cellulose, 14·4; albumenoid substances, 13·6; fatty matter, 2·2; ash, 3·2. During the subsequent mashing process, a large proportion of the dextrine is converted into sugar, and the starch into dextrine. The malt here alluded to is the so-called pale, that is, air-dried, malt.

Composition of Different Kinds of Porcelain.—M. Moron.—The materials used for the manufacture of porcelain vary, as will be seen, considerably. At Nymphenburg, Bavaria, the mass is made up of:—Kaolin from Passau, 65 parts; fine white sand, 4 parts; quartz, 21 parts; gypsum, 5 parts; broken-up biscuit, 5 parts. Vienna:—Kaolin from Zedlitz, 34 parts; kaolin from Passau, 25 parts; kaolin from Unghvar, 6 parts; quartz, 14 parts; felspar, 6 parts; metal (broken and ground-up china), 3 parts. Meissen, Saxon-Prussia:—Kaolin from Aue, 18 parts; kaolin from Sosa, 18 parts; kaolin from Seilitz, 36 parts; felspar, 26 parts; metal, 2 parts. The mixture of materials used at Sèvres is only known to those who have the management of that famous manufactory: the kaolin chiefly comes from St. Yrieux.

Pharmaceutische Zeitschrift für Russland, September, 1869.

This number contains the following original papers and communications:—

Monograph on Inuline.—M. Dragendorff.—This lengthy and exhaustive memoir is a compilation embracing everything relating to this subject. The paper is too lengthy to admit of suitable abstraction.

Chloroform, and its Behaviour towards Light and Air.—M. Hager.—The author made a series of researches with commercial chloroform obtained from a firm dealing wholesale in this article. The author's paper is divided into the following sections:—Chloroform of commerce contains, besides real formyl-chloride, other chlorinated compounds, which are not readily separated therefrom.—This is proved by the fact that, after the separation of alcohol and water, which are invariably present in all commercial chloroform, a fluid is obtained which begins to boil at from 60° to 61°, and at the end of the distillation boils at 65°. By repeated fractional distillation, it is possible to obtain pure chloroform, which can only be properly tested for by means of its boiling point and specific gravity. Pure chloroform is not decomposed by the action of light only.—When chloroform is exposed to the direct action of the sun's rays, it becomes decomposed, exhibits an acid reaction to test-paper, and there are found, among its products of decomposition, hydrochloric acid, chloroxycarbonic acid, formic acid, and free chlorine. Chloroform is decomposed when air has access to it, even in the dark, although only slowly.—A quantity of from 0·75 to 1 per cent of alcohol added to chloroform is sufficient to act as a preservative for keeping chloroform for years, even when exposed to daylight. Chloroform, even if it does not exhibit an acid reaction, may be in a state of decomposition.—This decomposition can only be detected by the reaction such chloroform exhibits with ammonia, which then yields with it vapours of chloride of ammonium. The cause and products of this decomposition are not ascertained. The boiling point and specific gravity of chloroform are variously determined by different authors:—The *Pharm. Austriaca*.—Boiling point, 63·5°; sp. gr., 1·49 to 1·5. Dr. Strecker—Boiling point, 61°. M. Limpricht—Boiling point, 62°. M. Bilts—Boiling point, 62·05°. Specific gravity—At 10·2°=1·5085; at 15°=1·5020; at 17·75°=1·4971; at 20·0°=1·4936.

Action of Iodine upon Arseniuretted and Antimoniuretted Hydrogen.—Dr. Husson.—The author finds that both these gases, when made to pass over iodine, readily yield iodides of arsenic and antimony. The author further suggests that this reaction should be made use of in toxicological investigations. For this purpose, when Marsh's apparatus is used, a small quantity of iodine should be placed in that portion of the tube where, commonly, the metallic mirror is made apparent; that part of the tube is gently warmed, so that the iodine coats the tube; and the gas is then made to pass, care being taken to keep the tube somewhat warm. Should the gas contain arsenic, a yellow-coloured mirror will be at once observed; when the gas contains antimony, an orange-coloured iodide of that metal is formed. The iodide of arsenic yields, when volatilised, yellow-coloured vapours, while the vapours of iodide of antimony are of a deep red hue.

Les Mondes, November 4, 1869.

We learn from this journal that M. Wurtz, the well-known scientific chemist, and Dean of the Medical Faculty of Paris, has been nominated Commander of the Order of the Legion of Honour. Among the number of scientific men who have been decorated as chevaliers of the same order, we meet with the names of MM. Schutzenberger, Friedel, and other well-known scientific men.

Navigation on Canals.—M. Bouquié.—Although this short notice does not exactly belong to the sciences usually treated of in our pages, we cannot refrain from quoting the following curiosity:—The distance from Mons (Belgium) to Paris, by canal, is 350 kilometres. The distance from Cardiff to Singapore is 25,000 kilometres; yet the journeys from Mons to Paris are performed by canal so slowly, that the journey from Cardiff to Singapore, if performed at the same rate of speed, would occupy eleven years. The coal-laden barges sailing between Mons and Paris make only three journeys during a whole year.

Manufacture of Manganate of Lime.—M. Delaurier.—Manganate of lime, CaO,MnO_2, can be directly obtained by heating together any oxide of manganese, previously reduced to powder, and mixed with slaked lime or chalk in equivalent proportions. The two substances should be intimately mixed, and heated to redness, with contact of air and constant stirring of the mixture, in order to promote the absorption of oxygen. This compound is insoluble in water; it is far more readily prepared than the manganates of soda and potassa, because these are fusible, and, hence, less manageable during the process. The manganate of lime yields oxygen on being heated by itself; and, when treated with sufficient sulphuric acid to convert the lime and manganese into sulphates, two equivalents of oxygen are given off. The waste manganese salts obtained in various manufacturing processes may be usefully applied to the preparation of the manganate of lime.

Apparatus for the Demonstration of the Fall of Bodies.—M. l'Abbé Vassart.

Boiling Point of Water at Localities the Height of which Above Sea Level has been Correctly Determined.—M. Ziurek.—The heights are expressed in metres, the average reading of the barometer at each locality in millimetres, the boiling point in °C. The highest inhabited spot on the globe is the township of Antisana, Peru (4101 metres above sea level)—Barometer, 454; boiling point, 86·3°. City of Quito (2908 metres)—Barom., 527; b.p., 90·1°. Santa Fé de Bogota (2661 metres)—Barom., 5·44; b.p., 90·9°. City of Mexico (2270 metres)—Barom., 5·72; b.p., 92·3°. Hospice du St. Gothard, Switzerland, the highest inhabited locality in Europe (2075 metres)—Barom., 586; b.p., 92·9°. Gavarni, France (1444 metres)—Barom., 634; b.p., 95·0°. St. Ildefonse Palace, Spain (1155 metres)—Barom., 657; b.p., 96·0°. Madrid (608 metres)—Barom., 704; b.p., 97·8°. Munich, Bavaria (538 metres)—Barom., 710; b.p., 98·1°. Moscow (300 metres)—Barom., 732; b.p., 99·0°. Rome (46 metres)—Barom., 756; b.p., 99·8°. Berlin (40 metres)—Barom., 756; b.p., 99·8°. As regards London, the enormous size of this province of houses makes it impossible to define, for that great extent, any average. Those portions nearest to the river are no more than about from 3 to 5 metres above sea level (not to be mistaken for what is locally known as Trinity high-water mark), while the more elevated portions are some 30 to 40 metres above the same level.

NOTES AND QUERIES.

By-Products Containing Soluble Phosphates.—Will any of your correspondents give information as to where any by-products can be obtained containing 3 per cent and over of soluble phosphate?—ARTHUR WARNER.

Preventing Moisture in Glass Cases.—Wishing to enclose a philosophical instrument in a second outer case of glass, where moisture is an enemy, can any correspondent inform me which is the best material to use, chloride of calcium, quicklime, $HO+SO_3$ dehydrated alcohol, or a small stick of sodium (to be scraped occasionally)?—S. E. P.

Standard Verification.—Having to deal with 1-1000ths of an inch, and having a friend who has to deal with 1-10,000ths of an inch, and finding a deplorable ignorance among the skilled artisans of London and an awful discrepancy with expensive gauges by Holtzaffel's, Elliott, and others, can any correspondent guide me to any system of standard verification? Outside the Greenwich observatory may be seen a standard of feet, inches, and moderate subdivisions. Is there any inner department for finer minutiæ available for the public?—S. E. P.

MEETINGS FOR THE WEEK.

THURSDAY, 18th.—Chemical, 8. Prof. Church, "On Namaqualite," and "Chemical Researches on New and Rare Cornish Minerals (No. 6)—A New Ferric Silicate." Dr. Stenhouse, "On Chloranil and Bromanil (No. 2)"

TO CORRESPONDENTS.

J. and E. Sturge.—Apply to Asher and Co., Foreign Booksellers, Bedford Street, Covent Garden.

E. U.—*Comptes Rendus* is published by Gauthier-Villars, Quai des Augustins 55, Paris.

J. Miller.—"Ancient and Modern Industry of the Chinese Empire" is published by Eugène Lacroix, Paris.

An Old Subscriber.—Reimann's "Handbook of Aniline," price 10s. 10d., post free, from our office.

Metallurgist.—You had better advertise in our columns for the situation you require.

W. U.—Mitchell's "Assaying" will answer your purpose best.

THE CHEMICAL NEWS.

VOL. XX. No. 521.

FLUX FOR BLOWPIPE ANALYSIS.

By Professor HOW, D.C.L., Windsor, Nova Scotia.

UNDER the heading given above, the CHEMICAL NEWS last year (vol. xviii., p. 203) reprinted a note by Mr. S. D. Poole to the *Scientific American* on the advantages of a mixture of selenite and fluor over the well-known flux of bisulphate of potassium and fluor devised by Turner as a reagent for producing coloured flames before the blowpipe, and over selenite alone as an addition to silicates, recommended by Fresenius. Mr. Poole's objection to the former is the intense violet tint given to the flame by potassium, and to the latter, its infusibility and want of decomposing power. This reagent, he says, "forms an easily fusible bead, which by itself gives only a very faint dull red tint (lime) to the flame, but which renders the presence of such elements as give colour most beautifully evident and characteristic."

My present object is to point out that the newly proposed flux is of more limited applicability than that of Turner, because there is no provision in it for the liberation of hydrofluoric acid. In testing for boracic acid *e.g.*, it fails completely to give the green flame with natroborocalcite and with borax, whereas Turner's flux gives a distinct reaction in each case. When silica is present in minerals along with much boracic acid, the addition of either of these fluxes is superfluous; thus with silicoboro-calcite a fine green—not yellowish green—is obtained with the mineral alone. Sussexite gives a yellowish green colour alone, and the addition of Poole's flux seems to me to obscure the reaction, while Turner's gives a fine green flame. As regards some other colouring elements, when colour is given by minerals alone, the best colour is obtained without the new flux; this is the case with celestine and strontianite. When silica is present, the test answers well in some instances, as with lepidolite and spodumene, and especially, as Mr. Poole states, with the felspars in which K and Na exist alone or predominate respectively. I may mention that small quantities of boracic acid which escape detection by using even Turner's flux, may be discovered in minerals soluble in HCl by repeated wetting and drying of the turmeric paper.

SUPERSATURATION, SURFUSION, AND SOLUTION.

By M. DUBRUNFAUT.

SUPERSATURATION is evidently a badly-defined phenomenon of solution; and a study of these phenomena is the only way of ascertaining the cause of supersaturation.

The interesting labours of M. Gernez, animated by the beautiful experiments of M. Pasteur, have established, in the most complete manner, the active part invariably played by the crystal which causes a cessation of the state of supersaturation in similar or isomorphous crystals. This proves the existence of a special power in the crystals themselves, varying in its mode of being according to their chemical and geometrical formation. But the labours of M. Gernez end here; they show, in fact, in the case of sulphate of soda, for instance, the generalisation of the long-known property possessed by a crystal of sulphate of soda of causing a supersaturated solution of the same salt to instantly assume the form of a crystalline mass. Nothing, however, of the cause of this fact, or of its relation with the condition of supersaturation, has been explained.

M. Loewel has fully proved, with regard to the supersaturation of sulphate of soda,* that the salt dissolved as the compound $SO_3NaO.10HO$ is found in solution in the state of $SO_3NaO.7HO$. The experimental demonstration of this fact appears to be the result of the exact analysis of crystals formed simply by lowering the temperature of the supersaturated liquid. The dissolved salt which is thus brought into a state of supersaturation changes its nature, or, at least, its molecular constitution. It now becomes a totally different product, possessing other properties, and that which is considered as supersaturation of the primitive product is really, in the new substance derived from it, merely a normal saturation; in other words, sulphate of soda is dissolved in water in the proportion of 10 equivalents of the latter, and, upon overcharging the solution with an excess of the salt, its composition is modified in such a manner as to create a new and more soluble product, consequently susceptible of producing that apparently strange phenomenon called supersaturation.

This interpretation of the facts relating to supersaturation does not detract the rules of the experimental method; and, by developing its logical consequences, the theory may be generalised and applied to all cases of solution, even to those not possessing the characteristic properties of supersaturation.

If it be certain (as we admit) that the sulphate of soda, with 10 equivalents of water, exists in the so-called supersaturated solution, with the molecular composition characterised by 7 equivalents HO, it is none the less true that, under certain known conditions, the composition of the salt may return to its primitive condition, which clearly proves, in the dissolved sulphate of soda, an unstable and fugitive molecular condition, which any accident or untoward circumstance may alter or destroy. This is what happens, in fact, under the influence of a crystal similar to sulphate of soda with 10 equivalents of water, or of an isomorphous salt; and, in this case, the return of the salt to its primitive composition is accompanied by a thermic manifestation, which confirms the change, such as may be noticed in amorphous allotropic changes, and in those of substances which crystallise in two shapes.

The modifications which matter presents in solution are confirmed, under another form, by the fact of double molecular rotation, which has been observed in crystalisable glucose, lactine, and their derivatives. In these cases, the crystallisable substances evidently contract the molecular constitution which they display at the moment of solution from the power of crystallisation, and it lasts sufficiently long to be quite perceptible. In the case of crystallised glucose, the transition of bi-rotatory to the state of monorotatory glucose requires, at a low temperature, four or five hours for completion.

This property is not perceptible in all molecularly-active substances, but it is believed to be general and proper, not only to all substances possessing the molecular property, but to all soluble substances whatsoever.

It is, therefore, highly probable that all soluble, crystallisable, or amorphous bodies have, when in solution, a different molecular constitution to that possessed by them when in a solid condition. This modification, as is proved by supersaturation and double rotation of glucose, is only ephemeral, and depends upon the particular condition of the substance in solution, and perhaps, also, on the nature of the solvents; it ceases when the causes which produce it are removed.

* M. Gernez, who has studied this subject with care, attributes the priority of the observations in question to foreign observers; but M. Loewel has also worked them out in a much better manner, without having previously heard of them, and therefore deserves the credit of an original discovery.

Thus it is retained by crystallised glucose in its crystalline state, whether its constitution be $C_{12}H_{12}O_{12}$ or $C_{12}H_{14}O_{14}$; but the moment that the crystal becomes liquefied, either by melting or by any kind of solvent, its molecular constitution, displayed by its rotatory power, is changed, and can only be regained by a return to the solid condition. Thus all known facts relating to supersaturation and surfusion may be explained without the necessity of distinguishing these different conditions of matter by the physical causes which annul them.

Solution, regarded thus, enters into the category of known chemical forces, which modify, in a regular and invariable manner, the arrangement of elements in integrant molecules.

After a careful examination of osmotic analysis as applied to complex saline solutions, I find that it is impossible to agree that diffusibility, which is, as we have demonstrated, the vehicle of this mode of analysis, occurs when the substance in question is in a solid state; on the contrary, everything goes to prove that the elements of the current of exosmose which produce the analysis are derived from a fraction of the solvent charged with the diffusible product. If this were not so, it would be difficult to account for what passes in my methodical analysis of molasses, in which the diffusion of sugar is constant at every period of the analysis, whilst the diffusion decreases geometrically in proportion as the analysis reaches its termination.

It certainly must be admitted that, in a solution of sundry salts, possessing different physical and chemical properties, each salt takes and retains, even in the complex solution itself, that contingent of the solvent assigned to it by its special qualities. It is upon these molecular liquid groups, which are more or less defined in every medium, that the force of diffusion is exercised which acts in so evident a manner in all cases of endosmotic analysis.

Here is another important fact in molecular physics which has been confounded by experimentalists with those of supersaturation.

When a crystallisable substance, such as sugar, is extracted from its solution in water by very strong alcohol, two different cases may arise, according to the conditions of the experiment, in which the sugar remains for a moment in a state resembling the phenomenon known as supersaturation, but which really differs from it essentially, or the sugar is precipitated in viscous lumps resembling precipitates formed under the same conditions by gum, dextrine, &c.

Upon examining this precipitate with a microscope, an amorphous or globular texture is easily observed, and these products float in the alcoholic solution. After a certain time, the viscous precipitate is transformed into well-defined prismatic crystals of sugar. These facts appear frequently, if not always, under the experimental conditions specified by M. Margueritte—to separate sugar from molasses by means of alcohol and sulphuric acid. This effect has been confounded with the known phenomenon of supersaturation. Under these conditions, alcoholic solutions said to be exclusively supersaturated furnish their contingent of sugar without change of density, which proves that all the sugar obtained was the result of amorphous sugar. Is not this transitory state of the sugar shown by the action of the alcohol on the dissolved sugar, the normal condition of sugar modified by solution? and is not this experiment a fresh proof in support of my mode of considering the phenomena of solution and supersaturation?

Is not that particular state of matter to which Mr. Graham has given the name of *the colloid condition*, a transitory and ephemeral condition analogous to that to which I have just called attention with regard to crystallisable sugar, and which is common to a number of other substances soluble and crystallisable from alcohol?—*Comptes Rendus.*

MODIFICATION OF THE METHODS FOR THE

VOLUMETRICAL ESTIMATION

OF THE

QUANTITY OF COPPER AND ZINC CONTAINED IN ORES

BY MEANS OF A STANDARD SOLUTION OF FERROCYANIDE OF POTASSIUM.

By M. MAURIZIO GALETTI,
Chief Assayer and Chemist of the Royal Assay Office at Genoa.

WHEN the ores of copper or zinc, after having been acted upon by acids, are treated with excess of ammonia in order to precipitate the oxide of iron, that substance invariably retains larger or smaller quantities of the oxides of the metals just named. The quantity thereof so retained varies according to the larger or smaller quantity of copper and zinc contained in the ores. It is hence necessary to repeat the treatment with ammonia at least twice, sometimes even three and four times, in order to obtain a complete separation of copper or zinc from the iron.

In order to obviate the loss of time which is caused by these operations, the author proposes to convert into acetates the small quantities of the oxides of copper and zinc which accompany the precipitate of oxide of iron. This can effected by two different methods, dependent on the fact whether the oxide of iron is removed by filtration (previous to the use of standard solution of ferrocyanide of potassium), or is left in the ammoniacal liquid. The operation is conducted as follows.

Suppose a copper pyrites to be submitted to analysis. Take 1 grm. of the previously very carefully pulverised and dried ore. Treat it first with concentrated nitric acid, boiling to incipient dryness, in order thereby to free the sulphur from any small particles of ore which at are first taken up by it. Add 10 c.c. of hydrochloric acid, boil down to about half that bulk, dilute with distilled water, and next add ammonia in large excess; boil the fluid, and next add pure acetic acid (sp. gr., 1·070) until the liquid assumes an emerald-green colour. After the liquid has been well stirred up, boil again for about two minutes; then add again ammonia in excess. The liquid is then poured out of the flask into a suitable glass vessel, and the flask is rinsed out with a sufficient quantity of distilled water to bring the bulk of the fluid up to ½ litre. This having been done, the fluid is very cautiously and gradually acidified with very dilute acetic acid, 1 part of the acid just alluded to, and 10 parts of distilled water. Any large excess of this acid should be avoided; the fluid should only be very slightly acid. As soon as the basic acetate of iron has subsided, the precipitation of the copper by means of the standard solution of ferrocyanide of potassium is proceeded with.

Since the oxide of copper which might have adhered to the oxide of iron has been converted by the process just described into a soluble salt, it cannot fail to be completely precipitated by the ferrocyanide of potassium solution. When a determination of copper has to be made in ores which are rather poor (that is to say, contain less than, or up to, 6 per cent of copper), it is preferable to add to the nitric acid solution 0·1 grm. of pure copper, which quantity has to be deducted afterwards from the results obtained. This precaution is required in order to prevent the presence of a large quantity of oxide of iron from vitiating the results of analysis of poor ores. When ores contain up to 12 per cent of copper, a quantity of 1 grm. of the ore should be taken; but, for richer ores, 0·5 grm. is sufficient. It is always advisable to make a control analysis with pure copper at the same time while testing the ores.

The second modification is carried out in the following manner.

After the second addition of ammonia to the liquid, it is filtered, and the precipitate is washed with a dilute and

boiling solution of acid acetate of ammonia. This solution is prepared by saturating 20 grms. of pure acetic acid with ammonia, and addition thereto of 15 grms. of pure acetic acid in 585 grms. of water. When the washing of the oxide of iron is carefully done, the salt of copper, which tenaciously adheres to the oxide of iron, is entirely removed therefrom; but it will require about 400 grms. of the fluid, the preparation of which has just been described.

The normal solution of copper should be treated as follows.

A quantity of 0·2 grm. of pure copper is dissolved in nitric acid; excess of ammonia is added; the fluid next acidified with acetic acid, thereupon diluted with 400 grms. of acid acetate of ammonia, and the whole brought up to 500 grms. To this solution 20 c.c. of the standard solution of ferrocyanide of potassium are added, and, after the necessary corrections have been made, the liquid must not contain any more excess of either copper or of ferrocyanide.

The standard solution of ferrocyanide of potassium to be used for the determination of copper is made by dissolving 50·225 grms. of ferrocyanide in as much distilled water as will suffice to make the solution weigh exactly 1 kilogramme.

The ferrocyanide solution destined for the estimation of zinc is made by dissolving 41·250 grms. of the said salt in the same quantity of water.

If it should happen that the copper ores contain zinc, nickel, and cobalt, the copper should be first separated from these metals, either by precipitating the copper from its solution in acid by means of zinc, or as sulphide of copper by means of hyposulphite of soda.

Zinc ores are treated in the very same manner as just described for copper ores. When sulphuret of zinc (the "black-jack" of English miners) is to be operated upon, care should be taken that, after the addition of hydrochloric acid, the fluid should be sufficiently far evaporated as to insure the expulsion of all nitric acid. Since zinc ores are usually rather rich, ½ grm. is sufficient for analysis. Calamine-stone (native carbonate of zinc) should at once be acted upon with hydrochloric acid; but, in order to make sure of the complete oxidation of all the iron the ore may happen to contain, it is best to add to the acid a few decigrammes of pure chlorate of potassa. After having suffered this solution to boil for a few minutes, it is diluted with distilled water; a large excess of ammonia is added to the solution, and it is next treated as above-described for copper.

The author states that he has convinced himself, by a set of experiments instituted on purpose, that the presence of compounds of lead (as, for instance, carbonate, sulphate, and sulphide of lead) occurring along with the ores of zinc, does not interfere with the correctness of the complete precipitation of zinc as ferrocyanide of zinc. This even holds good up to 10 per cent of metallic lead, a quantity which does not, also, interfere when mixed with copper ores.

Since some ores of zinc, especially calamine-stone, may, and often do, contain manganese, it is best to add to the ammoniacal solution, before any acetic acid is added, a few drops (from 2 to 4) of bromine, in order to convert thereby the protoxide of manganese into protosesquioxide, leaving the solution standing for twenty-four hours after the addition of the bromine.

Since the ammoniacal solution of chloride of zinc is colourless, there should be added to it, previous to the very cautious acidification by means of dilute acetic acid, a few drops of tincture of litmus, in order to more readily hit the precise point of sufficient acidification, to be exhibited by the blue colouration changing to a rose-red.

When iron is present, the same precautions are to be observed as described under copper.

The ferrocyanide of zinc which is mixed with oxide of iron preserves its naturally-white colour as long as the liquid yet contains free zinc, but its colour changes to a greyish white as soon as a very slight excess of the ferrocyanide standard solution is present; the liquid then also becomes turbid, and the precipitate settles very slowly. By these constantly-occurring and quite characteristic signs, the end of the operation may be always recognised. In order to make sure, the liquid should be stirred up with a glass rod which has been just previously moistened with an acidified and dilute solution of ammoniacal nitrate of copper, which will have the effect of indicating any excess of the ferrocyanide solution, by exhibiting the more or less intense colour characteristic of ferrocyanide of copper. The zinc solution should be at a temperature of from 40° to 50°, whereby the rapid precipitation and subsidence of the ferrocyanide of zinc is promoted.

When filtration is avoided, the presence of the gelatinous silica (due to the decomposition of silicates of zinc occurring in the ores of that metal, and brought to a gelatinous condition by the treatment of such ores with hydrochloric acid) does not interfere with the correctness and good results of this method of estimating zinc quantitatively in its ores.

It is gratifying to learn that, since the discovery of extensive and very valuable zinc ore deposits (calamine-stone) in the island of Sardinia, and the demand for this ore created in England, France, Belgium, and Rhenish Prussia, a committee of analytical chemists from these countries have, after having previously made themselves fully acquainted with the method of analysis of zinc ores just described, unanimously resolved to estimate the zinc (to be brought under contract to each of the countries just named from Sardinia) by the method here described, as being the best suited for the purpose.—*Zeitschrift für Analytische Chemie.*

ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 233.)

MANY other saline solutions will be found in microscopical works. The best have been given above; a larger selection would tend rather to confuse than assist the beginner.

Glycerine is one of the most valuable materials ever added to the resources of the microscopist. We are indebted to the late Mr. Robert Warington for the application of this fluid to microscopical purposes. It is obtained as a waste product in the manufacture of soap, and lead plaster. The quality of the glycerine from these sources is very inferior, being both weak and impure. The best is that made by Price's Patent Candle Company, and obtained by a distillation process. This is much purer and stronger than the common kind, having a specific gravity of about 1240, and is the only kind fit for use by the microscopist. The properties of glycerine as a means of giving transparency to an object have already been mentioned. It is a thick, syrupy, and highly refractive fluid, nearly colourless, and intensely but pleasantly sweet. Although made from fat, it is not at all greasy, but freely miscible with water and many other fluids; it is also a solvent for a great number of substances. Its action upon varnish has already been alluded to. It is stated by Dr. Carpenter that it dissolves carbonate of lime readily, and quite destroyed the calcareous skeleton of certain *Echinodermata* mounted in it. He suggests that, when used for such purposes, it should be saturated with carbonate of lime

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

by being kept in a bottle with some fragments of marble ("Microscope and its Revelations," fourth edition, p. 222). One of the advantages of glycerine is that it never dries; so that an object can be placed in it, covered with a glass, and left uncemented, without fear of evaporation for any length of time, and afterwards mounted permanently, if desired. Owing to its free miscibility with other substances, it forms many very valuable compounds, some of which will presently be described. A very full account of its use in delicate physiological investigations is given in Dr. Beale's "How to Work with the Microscope," a book of the greatest service to all intending to study the particular subjects upon which it treats. It is by the use of glycerine that Dr. Beale has succeeded in carrying on his elaborate investigations of the ultimate structure of nerve tissue under excessively high powers; and his processes afford a remarkable illustration of the support afforded to a delicate tissue by immersion in a fluid of extreme density, the manipulation of tender substances being comparatively easy in glycerine, when, in water or alcohol, it would have been impossible.

Strong glycerine preserves nearly every kind of object, whether animal or vegetable, with great perfection, and is, perhaps, the nearest approach to an universal mounting-fluid yet known. Insects and other objects may be put into a bottle of glycerine, and left until wanted; they are even better after a year or two's soaking. Objects mounted in glycerine generally improve after a time, details often being visible which were not seen immediately after mounting. The introduction of the binocular microscope has very much influenced the style of mounting objects to be viewed with low and medium powers. For this purpose, it will be found advantageous to mount the object with little or no compression. Of course, for examination with high powers, thin and compressed specimens are absolutely necessary (see author's paper, *Monthly Microscopical Journal*, vol. i., p. 331).

Glycerine can be diluted to any extent, either with camphor or creosote water, should it be desired to obtain a less refractive fluid, and one which does not render objects so transparent as pure glycerine; sometimes a portion of alcohol may be added with advantage. This compounding of media is one of the greatest arts in fluid mounting, and can only be acquired by experience, as, at present, no definite directions can be given. Diluted fluids, as a general rule, make animal tissues more granulous and opaque after a time than the strong, dense ones. The author possesses an instance of a difficult mounting accomplished almost by chance. The subject was the Medusoid embryo of *Hydra tuba*, which he had been observing at a friend's house. Thinking it a pity to lose a specimen then seen for the first time, he took the object home alive in its cell of sea-water, and then determined to attempt its permanent preservation. The course of operation was as follows:—The slide was placed in a saucer, which was quickly filled with strong alcohol (about 60 over proof). This fortunately killed the animal so suddenly that it was but little contracted. A mounting-fluid, consisting of glycerine, alcohol, and sea-water, was then extemporised, and the object mounted. It is still in good preservation, although somewhat opaque. It was mounted in February, 1862. This is given as an instance of the kind of practice occasionally needed in cases of emergency, and where the tact acquired by experience may be turned to good account.

It is occasionally convenient to make use of a medium which, while it is fluid at the time the object is mounted, will ultimately harden, and preserve the object from injury from being shaken or moved. Such media are especially useful for mounting *Diatomaceæ* attached to other *Algæ*. There are many compounds of this nature, some of the best of which are largely composed of glycerine.

The earliest of these was that known as *Deane's gelatine*. It is composed of—Gelatine, 1 oz.; water, 4 ozs.; honey, 5 ozs.; creosote, 6 drops; alcohol, ½ oz. The gelatine is to be soaked in the water until quite soft; the honey, heated to the boiling point, is to be added. The whole is then to be boiled, and, when it has cooled a little, the creosote and alcohol, mixed together, are to be added, and the whole filtered through fine flannel.

Glycerine jelly consists of gelatine soaked in camphor-water until it swells and becomes soft. The surplus water is to be poured off, and the jelly strained, and, if necessary, clarified after the manner of confectioners with white of egg. To every ounce by measure of this jelly add 1 drachm of alcohol and 6 drachms of Price's glycerine.

Both these media are used by melting the composition by placing the bottle in hot water, just as glue is melted. It is then used almost precisely in the same way as Canada balsam, taking the precaution to prepare the object by a previous soaking. Thin objects do not require a cell. When the gelatine has hardened sufficiently, the surplus portion is scraped off, and the slide cleaned. It should then be secured with a coat or two of liquid-glue, followed by several coats of gold-size, as in moist preparations.

A very useful medium of nearly similar properties is made according to the following formula of Mr. Farrants:—Picked gum arabic, 4 parts by weight; water, 4 parts; glycerine, 2 parts. The mixture is to be made cold, and, if necessary, strained through fine muslin. It is to be used in the same manner as the foregoing gelatinous preparations, only without heat, which renders it particularly fit for objects that will not bear the slight increase of temperature required to liquefy gelatine.

The action of all the above media is nearly similar to that of slightly diluted glycerine, excepting that, when set, they keep the object fixed in the position in which it was mounted.

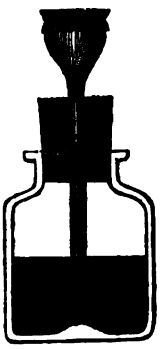
Strong syrup is capable of preserving animal and vegetable tissues, but is, under some conditions, liable to crystallise. The best proof of the perfect manner in which vegetable substances are preserved is given in the condition of preserved fruits, which are in an extremely favourable condition for microscopical examination. The samples of jam, &c., examined by Dr. Hassall, and reported upon in his "Food and its Adulterations," were probably among the tissues most easily identified, owing to their perfect condition.

Castor-oil will be found an excellent mounting-fluid; it penetrates, and gives considerable transparency, and keeps the object well and for a long period. It is particularly successful with parasitic insects; these may be placed in a bottle of castor-oil, and kept until required for mounting. As castor-oil is so readily procured, being in every medicine-chest, and to be obtained at any little village shop, it is a very useful medium for those who may wish to pre-

serve insects, &c., captured while travelling, as they need no attention after they are immersed in it. Should it be desired to mount the objects ultimately in some other medium, the oil can easily be removed by soaking in benzol.

Mounting-fluids which are in frequent use are best kept in a small, wide-mouthed bottle, through the cork of which is passed a pipette, surmounted by a funnel at its upper extremity, upon which is stretched a piece of sheet india-rubber (Fig. 18). By this

FIG. 18.



contrivance, a small quantity of fluid can be taken up, and delivered, drop by drop, upon the slide. Where mounting-fluids are continually required, as in pathological laboratories, Dr. Beale has contrived a little fountain on the principle of the wash-bottle, which answers admirably for a supply of any kind of fluid in drops; but, for the occasional use of the student, the pipette-bottle is to be preferred.

Closely connected with fluid mounting is the process of staining tissues. This is used for two widely different purposes. The first for rendering very transparent bodies more easily visible; this is easily done by immersion in magenta, diluted as the particular case may require. The other for more clearly defining certain parts, or parts in a particular state; this is done by using staining fluids which act unequally. For instance, if it be desired to stain the nuclei of cells, the following solution of carmine, described by Dr. Beale in "How to Work with the Microscope," and reprinted here by his kind permission, will answer admirably:—"Carmine, 10 grains; strong liquor ammoniæ, ½ drachm; Price's glycerine, 2 ozs.; distilled water, 2 ozs.; alcohol, ½ oz. The carmine, in small fragments, is to be placed in a test-tube, and the ammonia added to it. By agitation, and with the aid of the heat of a spirit lamp, the carmine is soon dissolved. The ammoniacal solution is to be boiled for a few seconds, and then allowed to cool. After the lapse of an hour, much of the excess of ammonia will have escaped. The glycerine and water may then be added, and the whole passed through a filter or allowed to stand for some time, and the perfectly clear supernatant fluid poured off and kept for use. This solution will keep for months, but sometimes a little carmine is deposited, owing to the escape of ammonia, in which case one or two drops of liquor ammoniæ to four ounces of solution may be added." For further information relative to the application of the staining process, and the observations to be carried out by its means, the student is referred to Dr. Beale's work.

Solutions of chloride of gold and nitrate of silver may also be employed to advantage (see paper by Dr. Bastian before quoted; T. Dwight, *Monthly Microscopical Journal*, vol. ii., p. 45).

(To be continued).

ON A NEW CHROMIUM OXYCHLORIDE.*

By T. E. THORPE, Ph.D.,
Assistant in the Laboratory of Owen's College.

WHEN chromyl dichloride $CrO_2\left\{\begin{matrix}Cl.\\Cl.\end{matrix}\right.$ prepared by heating a mixture of potassium dichromate, sodium chloride, and sulphuric acid, is maintained at a temperature of 180° C. —190° C. in a sealed tube for three or four hours, it is almost completely converted into a black solid substance, and on opening the tube when cold a considerable quantity of free chlorine escapes. By exhausting the tubes containing the liquid chloride before subjecting them to heat, I have ascertained that chlorine is the only gaseous product of this decomposition. The black compound invariably contains more or less of the liquid chlorine which has escaped decomposition: the greater part of this is easily expelled on gently heating the mass after opening the tube. In order to free it completely from the latter body, the black substance was transferred to a clean tube and heated to 120° C. (*i.e.*, about 2° above the boiling point of chromyl dichloride) in a current of dry carbonic acid gas until its weight appeared constant. The following determination of the amount of chlorine contained in the volatile portion shows that it is simply chromyl dichloride which has remained undecomposed.

0·8741 grm. liquid chloride gave 1·6458 grms. silver chloride.

Calculated for CrO_2Cl_2.	Found.
45·7 per cent.	46·5 per cent.

The solid substance dried in the manner above described appears as a black uncrystalline powder, which when exposed to the air rapidly deliquesces to a dark reddish brown syrupy liquid which smells of free chlorine. When thrown into water it quickly dissolves, forming a dark brown solution, which on standing also evolves chlorine. In nitric acid solution hypochlorous acid appears to be produced. In strong hydrochloric acid the substance dissolves with a dark brown colouration, and on boiling the solution, chlorine is evolved, the liquid becomes greenish yellow, and ultimately changes to the dark green colour peculiar to a solution of chromium sesquioxide in hydrochloric acid. When thrown into dilute ammonia, chromic acid is dissolved, together with all the chlorine, and a precipitate is formed possessing the properties of the chromate of chrome sesquioxide ($Cr_2O_3CrO_3$) described by Storer and Eliot. Upon this decompostion is based the method which I have employed for the estimation of the amount of chlorine contained in this body. The weighed quantity of the substance was treated with very dilute ammonia, the solution boiled for a few minutes, filtered, the precipitate well washed by hot water, an excess of nitric acid added to the filtrate, and the chlorine precipitated by the addition of silver nitrate. Two determinations of chlorine carried out in this manner on preparations made at different times gave the following results:—

Preparation I.

0·5900 grm. substance gave 0·4870 grm. silver chloride and 0·0069 grm. metallic silver.

Preparation II.

0·493 grm. substance gave 0·4250 grm. silver chloride.

Prep. I.	..	20·80 per cent Cl.
Prep. II.	..	21·32 „ „
Mean	..	21·06

* Read before the Manchester Literary and Philosophical Society, November 2, 1869.

In order to determine the amount of chromium it contains a weighed portion of the substance was repeatedly heated with strong hydrochloric acid on a water-bath until the evolution of chlorine entirely ceased; the solution was then diluted with water, heated to boiling, ammonia added in slight excess, and again boiled until the supernatant liquid appeared perfectly colourless. The precipitated chrome sesquioxide was then filtered, dried, and weighed.

Preparation I.

0·3442 grm. substance gave 0·2470 grm. chrome sesquioxide.

0·5900 grm. substance gave 0·4235 grm. chrome sesquioxide.

Preparation II.

0·5082 grm. substance gave 0·3590 grm. chrome sesquioxide.

0·5942 grm. substance gave 0·4210 grm. chrome sesquioxide.

Prep. I.	49·30	per cent	Cr.
	49·25	,,	,,
Prep. II.	48·45	,,	,,
	48·62	,,	,,
Mean	48·91		

Hence the percentage composition of the substance is as follows:—

	Found.	Ratios.	Calculated.
Chlorine	21·06	2	21·86
Chromium	48·91	3	48·54
Oxygen	30·03	6	29·60
	100·00		100·00

I have attempted to control the above empirical formula ($Cr_3O_6Cl_2$) by heating a weighed portion of the substance in hydrogen. The action of hydrogen upon the new chloride when heated is extremely energetic. At a comparatively low temperature it takes fire, combustion proceeds rapidly throughout the mass, and ultimately the substance is converted into chrome sesquioxide, hydrochloric acid, and water. Care must be taken to regulate the current of the hydrogen, since, if too rapid, particles of the finely divided sesquioxide are apt to be mechanically carried away. From an experiment, in which the gas was carefully purified from oxygen by passing it through strongly alkaline pyrogallate solution and over heated metallic copper, and then dried by transmitting it through tubes containing pumice moistened with strong sulphuric acid, the following numbers were obtained:—

0·8715 grm. substance gave 0·6150 grm. chrome sesquioxide.

Found 70·58 per cent Cr_2O_3.

$Cr_3O_6Cl_2$ gives by calculation 70·72 per cent.

I had an additional object in thus studying the action of hydrogen upon the new chloride. I considered that this action might, possibly, throw some light on the constitution of this compound. The new oxychloride may, in conformity with the analytical results, be regarded as a compound of chromous chloride with two equivalents of chromium trioxide. Now, chromous chloride, according to Moberg, may be heated in hydrogen to the softening point of glass without suffering decomposition, and if it were found that water was the only volatile product of the reaction, we should possess a certain amount of evidence for supposing that the formula $CrCl_2,2CrO_3$ represents the constitution of this substance. Experiment showed, however, that the chlorine was not so firmly united in this compound as in the chromous chloride: on gently heating the substance in hydrogen, hydrochloric acid was immediately evolved.

Péligot has described a series of salts to which are assigned the general formulæ MCl,CrO_3 and $M''Cl_2,2CrO_3$, where M represents a monovalent metal and M'' a divalent metal. The following are the names and formulæ of the salts prepared by Péligot.

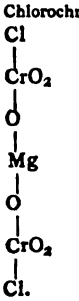
KCl,CrO_3	Potassium chlorochromate.
$NaCl,CrO_3$	Sodium chlorochromate.
NH_4Cl,CrO_3 ..	Ammonium chlorochromate.
$MgCl_2,2CrO_3$ ..	Magnesium chlorochromate.
$CaCl_2,2CrO_3$ ..	Calcium chlorochromate.

Now the new oxychloride stands in a very evident relation to these compounds. Supposing, for a moment, that the formulæ given to these substances correctly represent their constitution, then the new oxychloride may be regarded as the chromium term of the series—divalent chromium replacing magnesium or calcium.

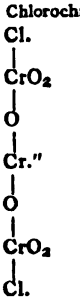
$$Cr''Cl_2,2CrO_3,$$

a formula identical with that of which I have just attempted to show the impropriety. But there is still another reason for supposing that a compound thus constituted could not exist. Chromous chloride is one of the most energetic deoxidising agents known, and we can hardly conceive it to be united in a stable compound with a substance which so readily parts with its oxygen as chromium trioxide. Hence I am disposed to regard the constitution of the salts of Péligot as very different from that implied by the above method of representation: indeed, to the best of my knowledge, the general formula assigned to these salts expresses not a single experimental fact, unless it be the mode of their decomposition by water; probably it had reference to the views of Rose and Berzelius respecting the constitution of the so-called chlorochromic acid. The following structural formulæ better represent, in my opinion, the constitution of these compounds and their relation to chromyl dichloride.

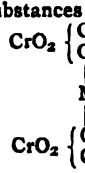
Magnesium Chlorochromate.

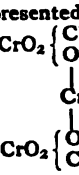


Chromium Chlorochromate.



These substances may also be thus represented—





The relation of the new oxychloride to chromyl dichloride is thus very apparent. Three molecules of chromyl dichloride when heated are resolved into one molecule of chromium chlorochromate and four atoms of chlorine.

PROCEEDINGS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

The opening meeting of the session was held on Monday, the 8th instant, when Dr. Wallace, F.R.S.E., F.C.S. Vice-President, in the absence of Professor Anderson, the President of the section, delivered an address.

Dr. Wallace congratulated the members of the section upon the success which had attended their meetings during the two previous sessions, and hoped that during the present winter they would give the office-bearers of the section their cordial support in endeavouring to pro-

mote the prosecution of scientific and applied chemistry in Glasgow. The Chemical Section had been a valuable feeder to the Philosophical Society, and had been a means of encouraging the formation of other sections, as well as stimulating the enterprise of chemists in other centres of manufacturing industry. The speaker then referred to the subject of technical education, and the necessity for the establishment of chairs of technical chemistry in our universities. With regard to the munificent offer of Mr. James Young, to found a chair of technology in connection with the Andersonian University, much sympathy was felt for the eminent professor of chemistry in that institution, but they all must regret that they had not amongst them so able a man and so diligent a worker as the gentleman who had been chosen to fill the chair. It was announced, however, that Mr. Young intended to form an independent school of chemistry in Glasgow. Dr. Wallace then gave a sketch of the life and labours of the late Mr. Graham, Master of the Mint, and gave an abstract of his most recent researches on hydrogenium.

The remainder of the address was occupied with a review of the latest contributions to theoretical and applied chemistry.

The next meeting of the section will be devoted to the election of office-bearers and other business matters.

NOTICES OF BOOKS.

Chemistry: General, Medical, and Pharmaceutical, including the Chemistry of the British Pharmacopœia. By John Attfield, Ph.D. London: John Van Voorst. 1869. 8vo; 624 pages.

The object of the author in compiling this work has been to combine a lecture-companion, reading-book, and practical class-guide in one. It is specially adapted to the wants of the medical and pharmaceutical student, and, with this intention, every substance which is employed in general practice as a remedial agent is chemically described. The work opens with advice to learners regarding the method of study; in which is detailed the requirements of various examining Boards, not, as might be supposed, suggestions as to the manner in which the study of chemistry should be begun, continued, and ended—supposing any ending of such a study were ever possible.

After a short introduction, a description is given of the non-metallic elements; and we can but think that a far too brief space has been allotted to these important bodies. There is, moreover, a want of definiteness which we regret to notice; take, for example, chlorine:—

"*Source.*—This element is a gas. Its chief source is common salt, more than half of which is chlorine. *Preparation.*—About ½ of an ounce of salt, and the same amount of black oxide of manganese, are placed in a test-tube, with sufficient water to cover them. On adding a small quantity of sulphuric acid, the evolution of chlorine commences. . . . During these manipulations, the operator will have noticed that chlorine is of a light green colour. . . . The distinctive property of chlorine is its bleaching power. . . . Chlorine readily decomposes noxious gases, and hence is one of the most powerful of *deodorisers*. Used in excess, it arrests and prevents putrefaction; hence is one of the best *disinfectants*. . . . After the gases (H and Cl) have mixed, the mouths of the tubes are quickly in succession brought near a flame, when explosion occurs, and fumes of hydrochloric gas are formed."

Now, we can imagine nothing more detrimental to the student than the singular want of exactness which is exhibited here at the very outset of the work. He will very naturally imagine that chlorine is a gas under all conditions known to us; that it is readily prepared without heat; that it possesses somewhat the colour of green peas, instead of, to our eyes, a dingy yellowish green, in which the yellow predominates over the green; that its chief property is its bleaching power; that it decomposes all noxious—that is, all unwholesome, or unhealthy, or hurtful—gases; and, finally, that hydrochloric acid gas is visible. We would particularly urge Mr. Attfield to attend more to details in the next edition of his work; for a chemical treatise which lacks accuracy is of little worth, specially to the student.

The "metallic radicals" are discussed at length and with some minuteness; the principal salts are described, and synthetical and analytical reactions are given, accompanied by a symbolic representation of the changes which occur. We are glad to notice that the derivation of words is introduced as frequently as possible, and though we cannot always agree with the roots which are given, it is undeniable that even an indication of the derivation of complex words often affords much assistance to the memory of the student. We would recommend to Mr. Attfield's notice, in connection with this subject, the "Essay on Metallick Words," of Sir John Pettus; the "Lexicon Etymologicon," of Gerard Vossius; and the useful little "Etymological Dictionary," of James Donald. The account of the metallic radicals is concluded by a useful "Analytical Chart for Metals," and by certain "Analytical Memoranda."

A detail account of the "Salts of Acidulous Radicles" is next given, then "Salts of Rarer Acidulous Radicles," their analytical detection, a very concise table of the solubility or insolubility of salts in water, and a chapter on "The Analysis of Salts."

About an eighth of the work is given to the following substances:—Alkaloids, Amylaceous and Saccharine Substances, Glucosides, Alcohol and Allied Bodies, Albumenoid and Gelatigenous Substances, Pepsine, Fatty Bodies, Resinoid Substances, Colouring Matters; and the following is an example of the mode of treatment:—

"*Strychnia or Strychnine.*—Formula, $C_{21}H_{22}N_2O_2$; molecular weight, 334. *Source.*—This alkaloid exists in nux vomica (*Strychnos nux vomica*), and in St. Ignatius Bean (*Strychnos Ignatius*), chiefly in combination with lactic acid. *Process.*—According to the official process for its preparation (*strychnos*, B.P.) the nuts, disintegrated by subjection to steam, and, after drying, grinding in a coffee mill, are exhausted with spirit, the latter removed by distillation, the extract dissolved in water, colouring and acid matters precipitated by acetate of lead, the filtered liquor evaporated to a small bulk, the strychnia precipitated by ammonia, the precipitate washed, dried, and exhausted with spirit, the spirit recovered by distillation, and the residual liquor set aside to crystallise. Crystals of strychnia having formed, the mother liquor, which contains the brucia of the seeds, is poured away, and the crystals of strychnia washed with spirit (to remove any brucia) and re-crystallised." "Properties." "Reactions." "The Physiological Test," which we certainly think might be conducted in a more humane manner, although the frog is, as usual, the victim. And *àpropos* of this, we all remember how the frogs once demanded of Jupiter a king, and what they got for it; now, considering how often frogs are sacrificed on the altar of science, we do think they have a right to demand something from Jupiter in recompense therefor. If there be any believers in metempsychosis in this age, let them think how terrible would be the second death of a relative whose soul had taken up its abode in a frog selected for Mr. Attfield's "Physiological Test." "A small frog" (there is a ray of humanity in the use of the word *small*, for the size might have been left to the discretion of the experimenter) "placed in an ounce of water, to which 1-100th of a grain of a salt (acetate) of strychnia is added, is, in two or three hours, seized with tetanic spasms on the slightest touch, and dies shortly afterwards."

The chapter on "Chemical Toxicology" appears to us to be precise and accurate, but far too short (seven pages) for so important a subject. The "Examination of Morbid

Urine and Calculi" occupies eleven pages, and is accompanied by some very good plates of urinary deposits drawn by Mr. H. B. Brady, who is a careful microscopist.

The remainder of the work is devoted to "Quantitative Analysis," and occupies about one-sixth of the entire contents of the book. It is divided into the following sections:—Introductory remarks; Measurement of Temperature; Specific Gravity; Weights and Measures; Correction of the Volume of Gases for Pressure and Temperature; Volumetric Analysis; Gravimetric Analysis; Dialysis. We may specially notice a very detail table (p. 459) for the quick conversion of thermometric degrees; a long list of specific gravities of "official liquids;" and comprehensive tables of from five to seven decimal places of metrical measures and their corresponding English representatives.

Throughout the work we find at the end of each chapter a list of "Questions and Exercises," containing in all 1031 questions. These should be carefully worked out by the student, and will do much to impress facts upon his mind; it is needless to say that the only way in which they can be beneficial is if they are answered direct from memory, not after immediate reference to the book; thus a chapter should be read and if need be re-read, and a week or fortnight afterwards the questions apertaining to it should be answered.

The appendix commences with a long "Table of Official Tests for Impurities in Preparations of the British Pharmacopœia," arranged in the form of "Name of Preparation;" "Impurities;" "Test;" "Page." This will be found of the very greatest value to the pharmaceutical student, and should be so tried and tested that it is fixed in his memory. Then we have "Saturation Tables," and tables of the percentage of various acids and alkalies in solutions of various gravity, and finally a list of the apparatus and reagents required for the three months course of practical chemistry at the hospitals. We are glad to congratulate Mr. Attfield upon an unusually good index containing more than 5000 references, and extending over forty-four pages. To still further facilitate reference, three kinds of type are introduced into the index, a practice which might more often be followed with much advantage.

The work is not remarkable for any speciality of treatment or design; it bears no great stamp of originality upon it, but there is evidence of much hard work, and it is eminently comprehensive. Mr. Attfield has, however, attempted to put too much into a small space; that which is gained in variety of matter is too often lost in clearness of expression and in detail. He has laboured well at the work, and has introduced the most recent matter (such as the accounts of apomorphia and apocodeia) but what the work really wants is a careful, and by no means hurried, examination of each individual part, with a view to greater accuracy with equal conciseness; it is a grand mistake to attempt too much in books of this nature.

Now the motto and key note of the work, which is to be found over against the preface, is taken from the "De Augmentis Scientiarum" of Francis Bacon, and is to the effect that some men seek for knowledge from curiosity and inquisitiveness, love of lucre, a livelihood, or reputation, and "but few for employing the Divine gift of reason to the use and benefit of mankind." If our author will look at the original passage, he will find the above a rather loose translation of the last phrase, for it is said "Paucissimi, ut donum ratione divinitus datum in usus humani generis impendant;" and if there were any other word expressing even a less number than "paucissimi" we fear it would have to be employed. If he be among those "paucissimi" he is indeed a happy man, and we envy him. And neglecting all the other reasons for which knowledge is coveted and communicated, who can say he is not among those of whom Bacon speaks as "alii existimationis gratia?" We candidly confess we cannot. No; if this work is to have a Baconian motto at all, we venture to imagine that this will be more appropriate:—"Homo Naturæ minister et interpres tantum facit et intelligit, quantum de Naturæ ordine, re vel mente observaverit; nec amplius scit aut potest."

The Sewage Question Settled by the Purification of Water, and the Manufacture, from Town Sewage, of a Dry and Portable Manure. London, 1869.

In this pamphlet we have an account of the works of the Native Guano Company, at Leamington. If the analyses which are given are reliable, the process certainly seems of much value. The organic matter is separated from the sewage by the addition of "a *solution* of animal charcoal, blood, clay, alum, magnesia, and other chemicals;" it is then allowed to settle, and, after drying in the air, it is ready for use as a manure. The supernatant fluid is colourless, and fish have lived for months in it. The deposit is in the form of a heavy black mud, about the consistency of treacle, and scentless. The following analysis shows the composition of the solid portions of the sewage, and of the fluid which remains after the addition of the compound which precipitates the organic matter (the bulk of liquid is not mentioned):—

	Organic Matter.	Mineral Matter.	Total.
Average of 50 samples of sewage	17·2	37·4	54·6
" " " effluent water	1·4	16·9	18·3

The town of Leamington has about 20,000 inhabitants, and yields nearly 600,000 gallons of sewage daily; from this about 5 tons per day of the dried manure is procured, inclusive of 10 cwts. of ingredients added as precipitants. The dry manure, as sold, possesses the following composition:—

Water	14·1
Organic matter	22·4
Phosphate of lime	9·6
Earthy and alkaline salts	11·2
Insoluble silicates	42·7
	100·0
Nitrogen = ammonia	4·2

The cost of manufacturing the manure is £1 10s. per ton, and it sells for £3 10s. per ton; and the total amount expended on the works has been less than £4000. It is very obvious that, until the precise nature of the substances added as precipitants is made known, together with detail and repeated analyses of the sewage, and of its precipitated products, it would be very unwise to do more than call attention to the scheme, the further application of which we shall await with some interest.

MISCELLANEOUS.

Production of Oxygen Gas.—Five hundred pounds of manganate of soda furnish two and a-half cubic yards of oxygen every hour. This charge is placed in a retort, and superheated steam passed over it; in *five minutes* all the oxygen is extracted from this quantity of the salt. Hot air passed over this residue for *five more minutes* restores all the oxygen given up, and the result of an hour's continuous work, or six extractions of oxygen and six re-oxidations, is two and a-half cubic yards of oxygen. This oxygen, when it issues from the gasometers, contains about fifteen per cent of nitrogen, but, by letting the first portions escape, the quantity of this mixture can be reduced to two and a-half per cent. M. Tessie du Mothay affirms that one ton of manganate of soda will yield one hundred cubic yards of oxygen daily, or more than 36,000 per year, *and this without having to renew the salt once.* —R. J. Fowler, *in the British Journal of Photography.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have effected arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, November 8, 1869.

This number opens with a—

Reply to the Last Note of M. Thenard on the Subject of the Heating of Wines.—M. Pasteur.—The purport of this paper is to refute some erroneous statements made on this subject, about which a great deal more fuss is made than is consistent with its importance.

The Changes which Flowers of Sulphur and Finely-Triturated Sulphur Undergo when Brought in Contact with Certain Soils.—M. H. Marès.—The author of this paper, a wealthy landed proprietor, and a scientific man of some standing, states the following facts:—Since the year 1854, the sulphuring of vines has become a regular practice in a portion of the south of France; on an average, there has been employed about 100 kilos. of sulphur to the hectare (2·471 acres), making, in sixteen years, 1600 kilos., although the quantity has been far larger in some districts. The question as to what becomes of all this sulphur has attracted the attention of the author, who has instituted a series of experiments and observations at Launac, near Montpellier. The main result of these researches is, that the sulphur is transformed into sulphuric acid, even during the dry summer season, in the short space of time elapsing between the beginning of July and the latter end of August. Sulphate of lime is formed, in case the soil is calcareous, as in the instance alluded to. The conversion of sulphur is more rapid in case the soil has been manured, but not a trace of sulphuretted hydrogen is then given off; or, if given off at all, it is immediately decomposed by the porous substance of the soil, and oxidised to sulphuric acid. The author found sulphate of lime even to a depth of 50 centimetres below the surface of the soil, which does not contain any of that salt but the merest trace, it being a well-known fact that Montpellier, and, indeed, the greater part of the littoral of the Mediterranean, in Southern France, is made up of a tertiary limestone formation. This mode of the disappearance of the sulphur explains the necessity of constantly repeating the sulphuring operation of the vines. The author observes that it appears that the presence of sulphate of lime is a prophylactic against the attacks of the vines by the *Phylloxera vastatrix*, since the vineyards in the Département de l'Hérault, which have been regularly sulphured, are free from the attacks of an insect which ravages at present the vineyards in the neighbouring departments of the Vaucluse and Bouches du Rhône.

Transformation of the Hydrate of Chloral into Chloroform within the Animal Body.—M. Personne.—According to M. Liebreich, the hydrate of chloral should be transformed into chloroform, when coming into contact with the alkali of the blood, according to the following formula:—

$$C_4HCl_3O_2,H_2O_2=C_2HCl_3+C_2H_2O_4;$$

that is to say, that the hydrate of chloral should become split up into chloroform and formic acid. This statement of the Berlin gentleman above named has been found incorrect by several French chemico-physiologists; and, in order to set the question at rest, the author of this memoir has instituted a series of experiments, partly with fresh blood, and partly with live animals, and has also made other crucial experiments, with the result that the hydrate of chloral is really split up—when in contact with blood in a living animal—first, into chloroform and formic acid, which, however, are ultimately converted into chloride of sodium and formiate of soda.

Chloride of Gold.—M. Debray.—The author says, It is a well-known fact that, when chloride of gold is submitted to a temperature of about 200°, it is first decomposed into protochloride of that metal and chlorine, and, if the temperature still rises, into chlorine and metallic gold. It is, however, possible to obtain crystals of chloride of gold by sublimation, by the following process:—A current of chlorine gas is made to act upon gold beaten out to a thin foil (not gold-leaf), placed in a glass or porcelain tube, and heated to 300°, at which temperature the volatilisation takes place and ruddy-coloured crystals of the chloride are obtained. The author observes that Boyle was the first who stated that chloride of gold is volatile, to some extent, without dissociation.

Bronze fit for Sonorous Instruments.—M. Riche.—It appears that, at the request of M. Dumas, in his capacity as President of the Committee for the French Mints, the author has made a series of experiments at the Hôtel de la Monnaie, Paris, on divers alloys of bronze brought from China and Japan, containing tin and copper in the proportion of 20 and 80. There have been cast, at the works just named, bars of bronze containing, respectively, 21·5, 20·0, and 18·5 per cent of tin; these bars have been submitted to hammering at temperatures varying between bright red heat and the ordinary temperature of the air. When cold, this metal is as brittle and as breakable as glass; at from 300° to 350°, a perceptible improvement takes place; and at dull red heat the metal works as easily as iron or aluminium bronze; even under the steam hammer, the metal is flattened without breaking, and may be beaten out to sheets of a millimetre thick, but requires, if hammered, a constant annealing; while, under the rolling-mill it is even better and more rapidly wrought. When hot, the metal can be cut as if it were iron or steel; with the latter metal it agrees in having a very fine grain and being very homogeneous. It can be soldered without difficulty with jewellers' solder. The density of these alloys was found to be as follows:—Bronze with 21·5 per cent of tin, after having been cast sp. gr., 8·938—after hammering, 8·929; bronze with 18·5 per cent of tin, cast sp. gr., 8·882—after hammering, 8·938; bronze with 20·0 per cent of tin, cast sp. gr., average of three estimations, 8·914—after hammering, 8·920. These alloys are very sonorous, and similar to that of the Chinese gongs.

Yellow Coralline.—M. Laudrin.—The author states that, according to his experiments, the yellow coralline is as little poisonous as the red dye of that name, also known as peonine.

Sugar Contained in Melons.—M. Petit.—The author has carefully studied the formation, as well as the disappearance, of sugar (crystallisable cane) in various fruits. As regards the melon, the rind never contains any other sugar than glucose; the pulp contains glucose in unripe state; and while the process of ripening is proceeding, cane sugar is formed, and increases in quantity, so as to be very soon in excess of the glucose. The formation of cane sugar begins in the most sour part of the fruit—that is to say, in the pulp surrounding the seeds; the formation of cane sugar is not, therefore, due to the previous existence of glucose, nor does the former result from the latter.

Polytechnisches Journal von Dingler, first number for October 1869.

This number contains the following original papers and communications relating to chemistry or allied sciences:—

Smoke-Consuming Furnace.—M. Miguet.—The consumption of smoke remains a great desideratum for industrial as well as domestic fire-places; from what is stated in this paper, to which some engravings are added, it appears that a real improvement has been made in this direction by the author, who is not, however, fully acquainted with what has been done concerning this subject in England.

Machinery for the Manufacture of Gas from the more Volatile Portions of Petroleum.—Dr. Petersen.—After referring to the advantages of gas for illuminating purposes in general, the author reviews and describes, accompanied and illustrated by engravings, some mechanism devised by German makers, for making and burning a mixture of air and vapours of what is now called gasoline; sp. gr., 0·682. The apparatus consist mainly of an air-compressing pump and reservoir for air; and for the gasoline, which, in a current of air, if not too cold, is readily and completely volatilised, and yields, on burning from an argand burner, a light equal to 18 standard candles, while the cost is only a trifle higher than good cannel-coal gas. Gasoline, as prepared on the large scale, is quite free from sulphur and ammonia, and its combustion is complete, resulting in the production of water and carbonic acid only. The apparatus, for five lights, costs 100 thalers (£15); for 200 lights, 750 thalers (£112 10s.).

Waters Contaminated with Fatty Matters considered as Feed-Water for Steam Boilers.—M. Triepike.—The author states that it has frequently been observed that new steam boilers have become quite unfit for service in consequence of getting leaky, and that this defect is due to the fact that the feed-water often becomes contaminated with dirty grease, which is forced into the boilers along with hot water, and is derived from the grease used in packing of the piston-rods and other parts of the machinery. The author states that the addition of 1 lb. of crystallised soda upon 10,000 lbs. of feed-water, is sufficient to prevent the effect ascribed to greasy matter taking place; and this confirms the observations made by MM. Börsig and Farcot, the eminent engine-builders of Berlin and Paris.

Quantity of Metallic Lead met with in Litharge.—Dr. Wittstein.—The author refers to the well-known mode of the manufacture of litharge on the large scale, and states that a colleague of his (an apothecary) had called his attention to the fact that it had often happened to him while making *emplastrum diachylon simplex*, to discover metallic lead in the vessel wherein that operation was performed The author instituted a series of experiments, which gave, as result, that, whereas some kinds of litharge are quite pure oxide, other samples contained from 1·25 to 3·10 per cent of metallic lead in finely-divided state. Pure litharge, free from metallic lead, should dissolve freely in acetic acid. If the litharge contains lead, it remains insoluble.

Bismuth from Peru.—Dr. Barth.—Since bismuth has become a rather expensive metal, more attention has been paid to the search for its ores. The author obtained a large sample of bismuth from Peru, which, on being analysed, was proved to contain, in 100 parts:—Bismuth, 93·372; antimony, with a little tin, 4·570; copper, with a trace of iron, 2·058. This bismuth is very valuable, on account of

being quite free from arsenic and sulphur, and is very suitable for pharmaceutical use.

Coal-Tar Colours.—M. Chateau.—100 lbs. of coal-tar yield—3 lbs. of raw, and 1½ lbs. of pure benzol. This quantity yields—3 lbs. of nitrobenzol, 2·25 lbs. of rosaniline, 3·37 lbs. of aniline red, and 1·12 lbs. of fuchsine; 1 lb. of pure fuchsine requires 3,000 lbs. of pit-coal. The quantity of coal-tar produced by the entire number of gas works of Europe is sufficient to yield, annually, 53,000 cwts. of fuchsine.

Analysis of an Eatable Clay.—M. Hebberling.—The author obtained, from a friend residing at Berbek, Kedirie, Java, a clay which is eaten by the natives and regularly sold in the markets. In 100 parts, this substance contains:—Silica, 39·711; peroxide of iron, 9·806; alumina, 25·939; lime, 3·025; magnesia, 1·352; protoxide of manganese, 0·591; potassa, 0·572; soda, 3·858; water and volatile matter (including 0·506 per cent of ammonia) 14·801—of this material, 72·792 per cent is insoluble in hydrochloric acid.

Les Mondes, November 11, 1869.

This number contains the following original papers and communications:—

Instructions Given by the Conseil de Salubrité (Board of Health) concerning the Use of Domestic Heating Apparatus.

Rendering Petroleum and Paraffin Oils Uninflammable and Inexplosive.—M. Garnier.—The author somewhat verbosely discusses this subject. The main facts brought forward are that experience has sufficiently taught that the temperature of minimum inflammability at 110° F. (43°) is too low, and that, very properly, that temperature should be altered to 180° F. (82°). The author next states that it is possible to render these oils uninflammable and devoid of smell by a chemical process which is not further explained, but which, while rendering the oils absolutely safe does not interfere with their proper use and applications.

Oleaginous Plants.—M. Heuzé.—Among the *accusés de réception*, attention is called to a very useful work, treating, in a practical manner, on all vegetables the seeds of which produce oil of any kind, recording the history, cultivation, diseases, and, in one word, everything relating to this subject. The book is highly eulogised as the work of a very competent authority who holds office as Inspector General of Agriculture.

Agronomic Stations and Agricultural Laboratories.—M. Grandeau.

Preservation of Beet-Root.—Count Robrinski d'Arlovetz.—One of the drawbacks of the manufacture of sugar from beet-root has always been, and is yet, the proper mode of preservation of the roots, which, in fact, is a problem not so readily solved, and least of all in countries subject to severe winters, since, if the roots are frozen, they are spoiled. The author is a large landed proprietor in Russia (where, by the bye, the manufacture of sugar from beet-root is greatly encouraged, it being the well-known policy of the Government of that empire to become, as much as possible, independent, for articles of home consumption, from other countries). The following conditions are to be complied with for properly attaining this object:—(1) No root should be at more than one metre's distance from a proper current of air; (2) every cubic metre of beet-roots requires at least a surface of 30 square decimetres, freely exposed to air; (3) that the cellars in which the roots are stored be aired every day, and care taken that the temperature therein does not rise above 4°; (lastly) care has to be taken that the roots do not become flabby by evaporation of too much water (10 to 12 per cent of their weight), in which case it would be necessary to water the roots, which, however, is always a dangerous proceeding, since it may lead to putrefaction.

Preservation of Stone by the Use of the Black Oxide of Copper and its Salts.—Dr. Robert.—This paper treats on a very interesting subject. The author proves that the decay of stone, granite, marble, limestones, sandstones—in a word, all natural building stones—is the effect of a concourse of various causes, and that among these a very minute lichen, the *Lepra antiquitatis*, is one of the worst enemies of the stone; and this to such an extent that, for instance, the beautiful marble sculptures of the well-known Parc de Versailles, will, unless proper measures are taken for staying the process of decay, be unsightly and ugly masses of dirt, and quite irretrievably lost as works of art within another fifty years. The author, taking as instances such buildings, at Paris, as the Bourbon Palace, the Palais du Corps Législatif, the Mazarin Palace (l'Institut), the Mint, and others, points out that dust, spider's-webs, and the action of rain combine with the minute lichen above alluded to, to call forth the decay of stone, especially of such parts, first, where any sculpture or ornamental carving promotes the deposition of dirt and dust. The author conclusively proves (and brings on instances which every one can see, and which, moreover, are important, in consequence of the length of time which has elapsed since the protective action of the black oxide and salts of copper commenced), that the action of the two last-named substances is, undoubtedly, preservative to stone. In reference to granite, the author states that (and an instance thereof can be seen at Waterloo Bridge) this stone is, also, according to the experience of Egyptian engineers, far more readily affected by a moist climate than one would be led to believe. The obelisk of Luxor, brought from Upper Egypt to Paris, has become blanched and full of small cracks during the forty years it has stood on the Place de la Concorde, while forty centuries had not perceptibly affected it as long as it was in Egypt. Granite, in a moist clime, becomes the seat of a microscopically-small cryptogamic plant, which greatly aids destruction; and it is, moreover, a well-known fact, that the disintegration of this stone, consisting of three separate minerals (quartz, mica, and felspar), depends very greatly upon the thorough and intimate mixture, as well as upon the chemical composition, of the same, each of these minerals, separately, being readily enough weathered.

Cultivation of Sugar-Cane in New Caledonia.—M. Joubert.—It appears, from a letter written by the person just named, that New Caledonia will become a sugar (cane) producing country. There are two sugar works in existence already, and two others are being built; the necessary machinery having been shipped from the Ile de la Réunion. Since it is a well-known fact that Cuba and other countries from which a very large proportion of the supply of sugar is obtained, are rapidly on the decline, as regards quantity, it is a gratifying fact to find that the country above named will soon be enabled to supply a not inconsiderable amount of this commodity.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 15, 1869.

From the *procès verbal* of the first meeting of this Society held after the holidays, we learn that, among other foreigners, the following Englishmen have been elected members:—Professor Crum-Brown, of Edinburgh, and Dr. W. Kellner, of Woolwich. The president, Prof. A. W. Hofmann, alluded, in a few words, to the death of the late lamented Mr. T. Graham, who was an honorary member of this Society. As a token of respect to the deceased *savant*, the assembly rose *en masse*, and a deep silence was observed for a few moments. The president next exhibited to the members a medal made of the alloy of palladium and hydrogenium, sent over by the late *savant* just alluded to, a few days before his death, to Professor Magnus, of Berlin; this medal bears on one side the effigy of Her Majesty Queen Victoria, and on the other side the name of Graham and the words "Palladium-Hydrogenium, 1869." There is added to the medal a short paper, which states that the medal contains 900 times its own bulk of hydrogenium, and, since the thickness of the medal is 1 m.m., a layer of hydrogen of a height of nearly 1 metre is condensed in that thickness of metal.

The following papers were read:—

On Chromates.—M. C. Freese.—The researches on this subject extend over a series of the salts alluded to, beginning with silver. The author distinctly points out that there exist only a neutral and a bichromate of the oxide of that metal, but no basic salt. The protoxide of mercury yields a normal neutral salt. By precipitating an excess of HgN_2O_6 with $K_2Cr_2O_7$, the precipitate obtained is not decomposed by washing with water. There exists only one basic chromate of peroxide of mercury. The older works on chemistry speak of basic chromates of copper of a green colour; the author says that green colour is due to basic sulphate of copper, or to hydrated oxide. The only known and well-defined chromate of copper, Cu_2CrO_5+2aq, is brown-coloured. Cupro-chromate of potassa is produced when cold solutions of $CuSO_4$ and K_2CrO_4 act upon each other; the double salt so obtained is split up by boiling water into K_2CrO_7 and sesquichromate of copper—

$$KrCu_3Cr_2O_{12}+2aq=(K_2Cr_2O_7)+(Cu_2CrO_5+2aq).$$

The chromates of zinc, cadmium, nickel, and cobalt are briefly alluded to, as, also, the basic chromate of protoxide of manganese.

On Sulphine Compounds.—M. Dehn.—The author says—Since it has been proved by M. Oefele that, when sulphide of ethyl acts upon iodide of ethyl, there is formed a monatomic radical, wherein the nitrogen is replaced by sulphur, I have tried to obtain similar compounds from diatomic alcohol radicals, using the sulphide of ethyl and bromide of ethylen as starting-point for my experiments. When these substances are heated in sealed tubes, along with water, to about 130°, two different series of action and products are observed; among these, triethylsulphine-platinchloride was obtained—

$$\left.\begin{matrix}C_2H_5\\C_2H_5\\C_2H_5\\Cl\end{matrix}\right\}S,PtCl_2;$$

also ethylen-diethylsulphine-platinum-chloride—

$$\left.\begin{matrix}C_2H_4\\C_2H_5\\C_2H_5\\Cl_2\end{matrix}\right\}S,2PtCl_2$$

also trimethylsulphine-bromide, C_3H_9SBr. In 100 parts—Carbon, 22·93; hydrogen, 5·75; sulphur, 20·38; bromine, 50·96. The paper enters into a lengthy discussion on the labours of MM. Cahours, Kolbe, and others on this subject.

Calculation of the Heat Emitted by the Combustion of Organic Compounds.—M. Thomsèn.

Contribution to the History of the Salicylic Compounds.—M. Henry.—This is the third portion of a memoir on this subject, subdivided into the following sections:—Nitrile of salicylic acid—

$$C_6H_4\begin{matrix}HO\\CN\end{matrix}$$

Nitrile of benzoyl-salicylic acid—

$$C_6H_4\begin{matrix}(C_7H_5O)O\\CN\end{matrix}$$

Metachlorobenzonitrile—

$$C_6H_4\begin{matrix}Cl\\CN\end{matrix}$$

Metachloronitrobenzonitrile—

$$C_6H_3(NO_2)\begin{matrix}Cl\\CN\end{matrix}$$

New and General Method for the Formation of Nitriles.—M. Henry.—The concluding portion of a long essay on this subject.

Some Sulphuretted Compounds of Isopropyl.—M. Henry.—This paper treats of:—Sulphocyanide of isopropyl, $C_3H_7.CNS$, a fluid of 0·963 sp. gr. at 20°, boiling at about 150°. Sulphur isopropyl, $(C_3H_7)_2S$, boils at 105°, and enters into combination with several metallic chlorides, the mercurial compound being a crystalline substance of the following formula:—$(C_3H_7)_2S,HgCl_2$. Mercaptanisopropyl, $(C_3H_7)HS$, boils at 45°, and acts energetically on peroxide of mercury, yielding a crystalline compound, $(C_3H_7)2HgS_2$; the alcoholic solution of this substance yields, with salts of lead, yellow-coloured precipitates, with acetate of copper a white-coloured precipitate, and the same with solutions of the salts of peroxide of mercury.

Some Derivatives of Oxybenzoic Acid.—M. Heintz.—The author describes the following substances:—A diethylether—

$$C_6H_4.OC_2H_5.COOC_2H_5,$$

a clear, colourless, oily liquid, boiling at 263°; its sp. gr., at 20°, is 1·0725; at 0°, 1·0875; its co-efficient of expansion is 0·000735. On saponification, this ether yields an acid, $C_6H_4.OC_2H_5.COOH$, a solid substance fusing at 137°; it yields salts with potassa, baryta, lime, and oxide of silver. Acetoxybenzoic acid, $C_6H_6.OOCCH_3.COOH$, a solid fusing at 127°, readily yielding salts with alkalies and the alkaline earths. Oxybenzoic-monethyl-ether, a fluid; formula—

$$C_6H_4.OH.COOC_2H_5;$$

freezes at −12°, but does not become fluid again until at 72°. (All the formulæ here quoted are exactly reproduced from the original.)

Action of Chloride of Mercury upon Sulphocarbanilide and Sulphocarbotoluide at a Higher Temperature.—M. Buff.—After referring to the experiments of MM. Merz and Weith on this subject, the author says—When a mixture of finely-powdered chloride of mercury and sulphocarbanilide is heated to about 150°, the mixture first fuses, next begins to give off a quantity of hydrochloric acid and sulphuretted hydrogen gases, and after the lapse of many hours the mass exhibited the odour of phenylsenföl (phenylated essential oil of mustard); while in the neck of the retort some crystals of hydrochlorate of aniline were found. The mass in the retort was first treated with boiling water, and next with alcohol, leaving a residue of mercury and sulphur; by this process, a basic substance, soluble in water, was obtained, which has been called tricarbohexanilide by MM. Merz and Weith, and triphenyl-guanidine by Prof. A. W. Hofmann. This substance fuses at 145°; when it is heated with sulphuric acid, sulphanilic acid is formed. The alcoholic solution yielded a solid crystalline matter, fusing at 235°, and exhibiting all the characteristics of a phenylated urea. When sulphocarbotoluidide is treated in the same manner, but at a temperature between 165° and 180°, a mass was obtained which exhibited a strong odour of oil of aniseed; the mass was at once exhausted with alcohol, yielding, after a complex process of purification, crystals of tritolylguanidine and sulphocarbotoluidide. The formation of tritolylguanidine is explained by the following formulæ:—

$$\left.\begin{matrix}CH_3-C_6H_4\\H\end{matrix}\right\}N-\underset{\underset{N}{\|}}{C}-N\left\{\begin{matrix}C_6H_4-CH_3\\H\end{matrix}\right.$$
$$C_6H_4-CH_3$$

A New Phosphamide.—M. Wichelhaus.—After referring to the labours of MM. Fittig, Gerhardt, Kekulé, and others, the author points out that, when phosphorus perchloride acts upon benzol-sulphamide, the product of that reaction need not be, as is generally supposed, benzol-sulphamide-chloride. On repeating the experiment, the author obtained, by means of a complicated set of reactions, a substance, $C_6H_5SO_2NPCl_4$; the reaction should, therefore, be represented by the following formula:—

$$C_6H_5.SO_2NH_2+PCl_5.Cl_2=Cl_2+HCl+C_6H_5.SO_2NHPCl_2.$$

The substance resulting from the benzolsulphamide appears to be a phosphamide, and is called by the author *benzolsulphurylbichlorphosphamide*—

$$\begin{matrix}NH(C_6H_5.SO_2)\\PCl_2\end{matrix}$$

Under the title of "Correspondence," M. V. von Richter writes from St. Petersburgh as follows:—The study of chemistry and the number of scientific chemists has of late years so rapidly increased in Russia that, after a general meeting of scientific men of the empire (held at the capital, in January, 1868), the Government permitted (on the 28th of October of that year) the establishment of a Chemical Society for the empire, upon the conditions that the seat of the Society should be the capital city, and that none but really scientific chemists should be elected as members. The president of the Society is elected for five years consecutively, and this office is held by M. Zinin. The meetings take place monthly, except the three summer months; at the meeting of 11-23 September last the following communications were made:—

Action of Iodine upon the Silver Compound of Succinimide Dissolved in Aceton.—M. Menschutkin. Iodine of succinimide is obtained in crystals belonging to the quadratic system; at 153°, this substance is decomposed, succinimide being again formed. Iodine does not act upon the sodium combinations of formanilide and acetanilide.

Benzimide.—M. Zinin.—The author states that, when this substance (formula, $C_{28}H_{18}N_2O_2$) is heated, along with water, in sealed tubes, it is split up into oil of bitter almonds and the amide of an acid as yet not well determined.

Nitrotoluol.—MM. Beilstein and Kuhlberg.—The authors exhibited a series of preparations of this substance; among these, solid nitrotoluol, boiling at 237°, and fluid nitrotoluol, boiling at 221°. The latter yields fluid isotoluidine.

Preparations of Thymol.—MM. Engelhardt and Latschinoff.—When thymol is acted upon by anhydrous phosphoric acid, propylen and γ cresol is formed. This latter substance differs from α and β cresol, which are obtained from two toluol-sulpho acids; but the boiling point of these three cresols is 190°. This concludes the correspondence from St. Petersburgh.

On Ethylenferrochloride.—M. J. Kachler.—When an ethereal solution of chloride of iron is heated for some hours in a sealed tube up to about 150°, a solid greyish-coloured substance is obtained. The author finds that this substance is, after having been purified, a compound $C_2H_4.Fe_2Cl_3+2H_2O$. The formation of this substance is represented by the following formula:—

$$\left.\begin{matrix}C_2H_3\\2C_2H_3\end{matrix}\right\}O+2Fe_2Cl_3=2(C_2H_4.Fe_2Cl_3)+2\left.\begin{matrix}C_2H_3\\H\end{matrix}\right\}O+2Cl.$$

This compound is not formed when the ether is perfectly anhydrous, and could not be obtained when, instead of ether, alcohol was used.

Balsam of Peru.—M. Kachler.—The author first reviews the labours of the large number of scientific men who have taken up and investigated this subject; and next describes, at very great length, his experiments, which gave, as result, that 100 parts of this balsam consist of 20 parts of benzile alcohol, 46 parts of crude cinnamic acid, and 32 parts of resin. There is appended to his paper a critical review of the labours on this same subject recently published by M. Delafontaine, from which it appears that the Peru balsam of commerce is a substance of variable composition, as has been very frequently brought forward and proved by scientific as well as pharmaceutical chemists.

Some Derivatives of Succinyl.—M. Weselsky.—The author describes:—Succinyl-phenol—

$$\left.\begin{matrix}C_4H_4O_2\\2(C_6H_5)\end{matrix}\right\}O_2,$$

is insoluble in water; soluble in ether, sulphide of carbon, and benzol; fuses at 118°; and boils and distils over, without decomposition, at 330°. Sulpho-succinate of potassa—

$$\left.\begin{matrix}C_4H_4O_2\\K_2\end{matrix}\right\}S_2,$$

is a solid substance, readily soluble in water, alcohol, and ether, and readily decomposed by acids, sulphuretted hydrogen being evolved. Sulpho-succinic acid, $C_4H_4O_2S$, also called sulpho-succinyl, is very soluble in water, alcohol, and ether, and exhibits a strongly acid reaction; with solutions of salts of copper, it is immediately decomposed, sulphide of copper being formed.

On Biniodide of Phenol.—MM. Hlasiwetz and Weselsky.—In the introduction to this paper, the authors review the history of some isomeric monoiodine phenols, and other compounds of phenol and iodine. Pure biniodide of phenol is a crystalline substance, readily soluble in alcohol, ether, and sulphide of carbon; fusing at 150°; subliming at a higher temperature; formula, $2C_6H_4I_2O+2H_2O$.

Products of the Oxidation of Toluol-Sulpho Acid by means of Fusing Caustic Potassa.—M. Barth.—This paper, and the next (by the same author)—

Constitution of Phloretinic Acid and Tyrosine—Are not well suited for abstraction.

On Sulphoxybenzoic Acid.—M. Senhofer.—By a lengthy process, too long for quotation, the author obtained sulphoxybenzoic acid in pure state. It is a crystalline bright green-coloured substance, $C_7H_7SO_6$, not precipitated by neutral acetate of lead, and yielding, with chloride of iron, a wine-red colour; at 160°, it loses water; the acid fuses at 208°. This acid forms compounds with lead and cadmium; the latter is an acid salt. Formula, $2(C_7H_5SO_6)Cd$. The acid does not readily form salts with alkalies.

New Mode of Formation of Protocatechuic Acid.—M. Malin—The author finds that, when sulphanisic acid is heated with fusing caustic potassa in excess, care being taken to regulate the temperature properly, and to avoid a too long continued action of the potassa, the result is the formation of protocatechuic acid; when the action is too long continued, hydrochinon is, however, formed. The acid obtained was found, on elementary analysis, to yield—C, 54·7; H, 4·0. Dried at 100°, this substance lost 10·5 per cent of water. The quantity of protocatechuic acid obtained from 16·6 grms. of sulphanisic acid amounts to about 2 grms.

Pettenkofer's Method for the Determination of Carbonic Acid.—Dr. Gottlieb.—The author states that, while, with the method alluded to, the accuracy thereof mainly depends on the care taken in the preparation of the turmeric paper used in this process (which is not described, but understood to be generally known), he has found that, when proper precautions are taken, the pigment of litmus answers the purpose as well. For this purpose, the litmus is exhausted with alcohol at 85 per cent, until it only assumes a very slight violet tinge. The alcohol is removed by evaporation on a water-bath, leaving behind a deep violet-coloured amorphous mass, the largest part of which is soluble in cold water, yielding a solution which, on the addition of an acid, assumes the well-known red colour, known as *rouge pelure d'oignon*, while alkalies do not affect it. The remainder of the litmus (insoluble in alcohol) is treated with water, yielding a blue pig-

ment insoluble in alcohol; this aqueous solution is, after removal, by filtration, of the substances of the litmus insoluble in water (impurities), at first, violet-blue coloured; but this tinge changes, on the addition of more water, into a pure blue, which, by the addition of acids, soon becomes beautifully red (*pelure d'oignon*), which tinge, however, does not become apparent unless a larger quantity of acid has been added. The author, therefore, adds to a portion of the blue-coloured fluid guttatim, some very dilute hydrochloric acid, until the fluid has assumed a wine-red tinge. When this point has been reached, the rest of the blue (original) liquid is added; and in this manner a fluid is obtained which answers the purpose of working, according to Pettenkofer's method, better than turmeric paper or tincture, since the author states that, on instituting comparative tests and assays, he found it easy to estimate to within 0·0007 grm. of carbonic acid.

NOTES AND QUERIES.

Bisulphite of Lime.—How is the "bisulphite of lime solution" which is now largely sold, possessing as high a gravity as 1·072, practically made?—A. N. Palmer.

Shoddy.—Can any of the subscribers of your valuable journal inform me the best means of reducing shoddy by acid, for mixing with phosphatic material as a manure.—Child.

Preventing Moisture in Glass Cases.—(Reply to "S. E. P.")—Use quick-lime, which absorbs both moisture and carbonic acid, and put in the case a piece of camphor wrapped in muslin, and you will not be troubled with moisture.

Standard Verification.—(Reply to "S. E. P.")—We believe that a polite application to the Astronomer Royal would obtain you what you desire; there is no doubt that at the Observatory they have the means as well as the goodwill to give every assistance for such objects.

Bleaching Syrups.—(Reply to "Andrew Van Bibber").—You can hardly expect to attain your object at all, since the colour of these syrups is due, in the first place, to caramel, and also to peculiar impurities, from which the sugar is only liberated by a process of washing with a very concentrated, and quite colourless, syrup made on purpose from best refined sugar. Filtration through charcoal (animal) will decolour these green syrups, as they are technically called, to a limited extent, and then only after having been somewhat diluted with hot water, and the filtration taking place in a room where the temperature should not be less than 80° F. By means of very finely divided pipe-clay, added previous to filtration, you may obtain a greater degree of decolouration, but it is impossible to bleach, as you call it, these syrups entirely, and since you have to dilute with water before filtration, you would have to evaporate that water afterwards, and unless that were done in a vacuum pan, your previous operations would be of little avail.—X.

Detection of Prussian Blue in Black Ink.—Prussian blue is either neutral or basic. Neither of these are soluble in water; for, although it is stated that the basic blue is soluble therein, this is incorrect, since the apparent solubility is due to an excess of the ferrocyanide of potassium. There is no means of dissolving Prussian-blue but by the use of acids, which would altogether destroy, and be incompatible with, black ink as usually made, since these acids are just those which are used to obliterate the stains of black ink. Prussian blue is decomposed by alkalies; but these would also destroy ordinary black ink. It is not very likely that ink should be tinged blue by Prussian-blue; it is probably coloured blue by a few drops of indigo carmine. As to the detection of logwood in ink, it should be borne in mind that almost all black inks are partly made with logwood, and that a tolerably good black ink is made of logwood decoction and neutral chromate of potassa. The detection of logwood is based upon the reactions of hæmatoxyline and hæmateine, but the details thereof are too lengthy to be here quoted, and can be found in works on organic chemistry.

Terra Alba.—In further reply to "Selenite," it depends upon what purpose he intends or wishes to apply it—which variety is to be preferred. Chemically, they are all the same, except that the commoner kinds contain more or less foreign matter, such as oxide of iron, &c. The best kind is carefully picked out and ground into what is technically termed "terra alba," and by some people "pearl white;" this portion is so white that it looks like good loaf-sugar. The more coloured varieties, or parts of the vein (*i.e.*, the pieces rejected as unfit for terra alba), are ground up separately, and are technically called gypsum. These kinds need no drying; but when either kind is baked, so as to lose its water of crystallisation, it becomes the setting plaster, known as plaster of Paris, used by plasterers. Terra alba (*i.e.*, the natural product) is sold very much cheaper than the artificial one made under Jullien's patent. French artificial sulphate of lime is made like Jullien's, by precipitation, I think, by Prof. Kuhlmann, but it is no better than native terra alba, or Jullien's pearl-hardening. As the artificial article would, if over-dried, lose parts of its water of crystallisation, it is never thoroughly dried. It is almost impossible to enumerate the many uses to which gypsum (a term which includes the whole) is applied; it is, however, largely used for manure, as an absorbent of ammonia, by colour makers, paper makers, and several other trades. Large quantities of the commoner kinds are made in Carlisle and that neighbourhood, and quantities of the stone are shipped, from the Seine, to Leith and other places, where it is ground, but the French stone is not good enough to make terra alba. If "Selenite" sends me his address, I will send him a pamphlet on the subject, containing the largest amount of information he can get about it, and which would be too much to be given through your columns. Jullien's patent is an English one.—Nemo.

MEETINGS FOR THE WEEK.

Monday, 22nd.—Medical, 8.
—— London Institution, 4.
Wednesday, 24th.—Society of Arts, 8.
—— Geological, 8.
Thursday, 25th.—London Institution, 7.30.
—— Royal, 8.30.
—— Zoological, 8.30.
Friday, 26th.—Quekett Club, 8.

TO CORRESPONDENTS.

R. Tatlock.—Communication received with thanks.

D. W. L.—Bloxam's "Laboratory Teaching," published by Churchill, will answer your purpose best.

J. B.—(1) A good cement for sulphide of carbon prisms is isinglass dissolved in weak spirit. (2) Heat and good ventilation will remove the smell of wood-tar from a room.

Professor Tennant, F.G.S., will deliver a Course of Lectures on MINERALOGY applied to GEOLOGY and the ARTS, at King's College, London, on Wednesday and Friday mornings, at nine o'clock, during October, November, and December, commencing October 8th. Fee, £2 2s.

A Course of Lectures on MINERALOGY and GEOLOGY will also be delivered, on Thursday evenings, at eight o'clock. These begin October 14th, and will be continued to Easter, 1870. Fee, £1 11s. 6d. Professor Tennant gives Private Instruction in Mineralogy and Geology, Illustrated by a large number of Specimens, at his Residence, 149, Strand, W.C.

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Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c.

TO PHARMACEUTICAL AND OTHER STUDENTS.

Mr. J. C. BRAITHWAITE, for thirteen years Principal Instructor in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c., wishes to inform his old Pupils and others that he continues to devote his whole attention to Education.

The Session 1869—1870 will commence on the 4th of October, when Mr. BRAITHWAITE'S Laboratory, which has been enlarged, will be re-opened at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS meets as usual every Monday and Thursday Evening, at 8 p.m., commencing October 4th.

The LATIN CLASS for the reading of the Pharmacopœia, Physicians' Prescriptions, &c., every Tuesday and Friday Evening, at 8 p.m., commencing October 5th.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday Evening, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday until further notice.

Fee to either of the above Classes Half-a-Guinea per Month; to the Botanical Excursions only, Half-a-Guinea per Eight Lessons. Pupils can enter at any period.

Gentlemen privately prepared for the Examinations of the Pharmaceutical Society, &c., the "Special Examination for Chemists in Business," and for the "Modified Examination for Assistants."

All Fees must be payable in advance.

Letters of inquiry should be accompanied with a stamped envelope Address, 54, Kentish Town Road, N.W.

Mr. Braithwaite receives a few Pupils to board in his house.

THE CHEMICAL NEWS.

VOL. XX. No. 522.

THE LATE ECLIPSE, AND ITS OBSERVATIONS IN THE UNITED STATES.

As might be expected from the easy accessibility of the entire line of totality, this eclipse has been most thoroughly observed by numerous parties, the report of whose work will in due time be presented to the scientific world. Among the methods of observation, photography played an important part, and we have now before us an admirable series of views obtained by a large party organised and conducted by Dr. Henry Morton, Professor of Chemistry in the University of Pennsylvania, whose communications have sometimes appeared in our columns.

These pictures show, in the first place, very fine definition in the telescope employed, as the roughness or mountainous character of the moon's edge is clearly given in the pictures of partial phase, as well as the sun-spots and surrounding faculæ.

Thus, Professor A. M. Mayer, who took charge of one of the three sections of Professor Morton's party, has shown, by measurement on the photographs, a change of shape in one of the larger spots during the eclipse, amounting to a motion of 2000 miles in its edges.

During totality, no less than thirteen negatives were secured, showing a large number of prominences, some massive and others delicate, as well as radiant brushes of a softer light, such as have been before seen, but never as yet photographed. By another of the sections of this large party, beside similar pictures to the above, one was obtained showing the curious phenomena known as Baily's beads.

The time of exposure determined by Professor Mayer for the partial-phase pictures was the 1-500th of a second. Those taken during totality were exposed from five to sixteen seconds.

The *Journal of the Franklin Institute* for September has sixteen pages devoted to Professor Morton's report of his expedition to Professor J. H. C. Coffin, U.S., N. Supt. of the *Nautical Almanack*, under whose authority this and other expeditions were organised, with an admirable photograph from one of the totality negatives, and several woodcuts.

One of these, showing the general character of the prominences, we here give.

The line A B represents the direction of a parallel of declination; C D a declination circle. F E is the moon's path from first contact at F. The prominences are here all shown at once; although, of course, those on the sun's eastern limb alone were seen at first, those on the west side only at the end of the totality.

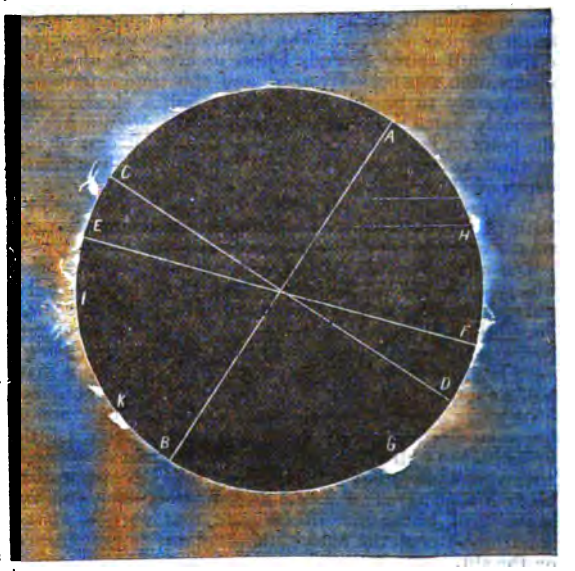
In the October number of the same journal, of which advanced sheets have been sent us, thirty-eight pages are devoted to the reports to Dr. Morton of those in charge of the various departments. From these we extract some of the most interesting portions as follows.

PHOTOGRAPHS OF THE CHROMOSPHERE.

Dr. B. A. Gould writes:—An examination of the beautiful photographs made at Burlington and Ottumwa by the sections of your party in charge of Professors Mayer and Himes, and a comparison of them with my sketches of the corona, have led me to the conviction that the radiance around the moon in the pictures made during totality is not the corona at all, but is actually the image of what Lockyer has called the chromosphere.

This interesting fact is indicated by many different considerations. The directions of maximum radiance do not coincide with those of the great beams of the corona; they remained constant, while the latter were variable. There is a diameter approximately corresponding to the solar axis, near the extremities of which the radiance upon the photographs is a minimum, whereas the coronal beams in these directions were especially marked during a great part of the total obscuration. The coronal beams stood in no apparent relation to the protuberances, whereas the aureole, seen upon the photographs, is most marked in their immediate vicinity; indeed, the great protuberance, at 230° to 245°, seems to have formed a southern limit to the radiance on the western side, while a sharp northern limit is seen on all the photographs at about 350°, the intermediate arc being thickly studded with protuberances which the moon displayed at the close of totality. The exquisite masses of flocculent light on the following limb are upon the two sides of that curious prominence at 93°, which at first resembled an ear of corn, as you have said, but which, in the later pictures, after it had been more occulted, and its southern branch thus rendered more conspicuous, was like a pair of antelope horns, to which some observers compare it. Whatever of this aureole is shown upon the photographs was occulted or displayed by the lunar motion, precisely as the protuberances were. The variations in the form of the corona, on the other hand, did not seem to be dependent in any degree upon the moon's motion.

The singular and elegant structural indications in the special aggregations of light on the eastern side may be of high value in guiding to a farther knowledge of the chromosphere. They are manifest in all the photographs by your parties which I have seen, but are especially marked in those of shortest exposure, such as the first one at Ottumwa. In some of the later views, they may



be detected on the other side of the sun, though less distinct; but the very irregular and jagged outline of the chromosphere, as described by Janssen and Lockyer, is exhibited in perfection.

This happy result is clearly attributable to the relative shortness of the time of exposure, by which the highly photographic rays of the chromosphere have depicted themselves, without obliteration by the mass of coronal light which veiled them from the eye. Let us hope that, at the next total eclipse, some impressions may be taken with an exposure not exceeding a single second. The inference seems warrantable, that, in this way, better than in any other, the internal structure of the protuberances

may be exhibited, though other phenomena may fail to record themselves.

You will observe that some of the brighter, petal-like, flocculi of light have produced apparent indentations in the moon's limb at their base, like those at the bases of the protuberances. These indentations are evidently due to specular reflection from the moon's surface, as I stated to the American Association at Salem, last month. Had any doubt existed in my mind, previously, it would have been removed by an inspection of the photographs.

Abstract of Professor Young's Report.

The observer was a member of the party under the direction of Professor J. H. C. Coffin, of the *Nautical Almanac* Office, stationed at Burlington, Iowa.

The instrument employed was a spectroscope with 5 prisms of 45° each, having faces 2¼ by 3¼ inches; the collimator and telescope had apertures of 2¼ inches, with a focal length of 17. These were connected with a "comet seeker" of 4 in. aperture and 30 in. focus, used with an eye-piece, and giving an image of the sun, 2¼ inches in diameter, on the slit of the spectroscope. A graduated screen at the slit determined positions of points on the sun's limb, and a wire micrometer measured the positions of spectrum lines. The whole was mounted equatorially with slow motion screws.

Protuberances were noted before the eclipse at + 85° to 100°, large and not very bright; at + 146°, small and bright. The photographs show another at 155°, which escaped notice; also at −70° to 80° low, but pretty bright; and at −130°, very large and bright, the principal one. Angles are reckoned on the sun's limb from the North point, + towards the East, − towards the West.

The first contact was observed by watching the gradual shortening and final extinction of the *bright line*, C, in the spectrum of the prominence, which happened to be at the point of contact. The moon's approach was perceived full thirty seconds before its actual appulse; the observation was perfectly easy, and the time determined is certainly to be relied on within half a second, and probably much less. The presence of a prominence at the point of contact is not essential to the success of the method, as there is everywhere on the sun's limb sufficient depth of chromosphere to answer the purpose.

It is proposed to apply the spectroscope to observations both of the external and internal contacts at the next transit of Venus.

During the totality, the following nine bright lines were observed in the spectrum, viz., C, dazzling in brilliance; 1017·5 (near D, the numbers refer to Kirchhoff's scale,) very bright, but not equal to C; 1250±20, very faint, position only estimated; 1350±20, like the preceding; 1474 (a little below E,) conspicuous, but not more than half as bright as 1017·5; F, next to C in brightness; 2602±2, a little fainter than 1474, position determined by micrometrical reference to the next; 2796. a little below G, the well-known Hγ line in brightness between 1017·5 and 1474; and finally *h*, or Hδ, somewhat brighter than 1474. *b* was not seen, it is supposed, on account of a mistake in carrying that portion of the spectrum through the field while there was no prominence on the slit.

*The line 1474 was recognised as belonging to the *spectrum of corona*, in the first place, by its extending clear across the spectrum, while 1017 did not, and then by its remaining visible when the slit was moved away from the protuberance, while the other lines (C and 1017) disappeared. The impression of the observer is that faint lines 1250 and 1350 behaved in the same manner, but his recollection as to this point is not very certain.

These three lines, 1250, 1350, and 1474, coincide far within the probable errors of observation with three lines observed by Prof. Winlock in the spectrum of the Aurora Borealis. The first two are not accurately enough determined, in position, to allow much stress to be put upon any apparent coincidences on their part, but the last is perfectly well known, and its exact agreement throughout with one of the fainter lines of the Aurora, when combined with the general appearance of the Corona and other considerations, give a good deal of probability to the conjecture that *our Aurora Borealis and the Solar Corona are identical phenomena*.

The line 1474 is given by both Kirchhoff and Angström (not by Huggins, who, however, omits many faint lines,) as belonging to the *iron* spectrum, and this suggests the inquiry whether we are to admit the existence of *iron* in the auroral heights of our atmosphere, or are to account for this line in the iron spectrum by some unknown substance of gaseous nature.

The corona showed, also, a faint continuous spectrum without *any trace of dark lines*. The light of this faint spectrum, tested by a tourmaline held in the hand next the eye, was strongly polarised in a plane passing through the sun's centre. As the direction of the spectroscope slit was nearly radial, it is not impossible that Prof. Pickering may be right in explaining this polarisation as caused by the successive refractions through the prisms.

Professor Young's Determination of First Contact.

In our notice of this subject we omitted to state that Prof. Young finds that the presence of a prominence at the point of first contact, though facilitating the process is not essential to his method, since the spectrum of the chromosphere is quite enough for the same purpose.

The Corona and its Photographs.

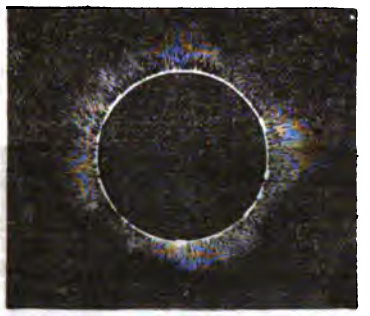
It is a very fortunate thing that the numerous parties by whom photographs were made of the late eclipse, in hardly any two instances followed the same plan of arrangement or aimed at the same class of results. Thus, the Philadelphia Expedition, in pursuance of Professor Coffin's suggestions, made their preparations with the view of obtaining such "accurate and well-defined pictures as might be the basis of astronomical calculations." In this they have unquestionably succeeded beyond all others, as we hear from all sides, now that pictures have been distributed and compared. Their views of lunar mountains, sun-spots, faculæ, chromosphere, and crepuscule being unapproached, and their views of the solar prominences only rivalled by one obtained by Dr. Curtis.

The party under Prof. Pierce, consisting, photographically, of Mr. Whipple, of Boston, (who, with Mr. Black and the late Prof. Bond, of Cambridge, made, in 1850, the first celestial photograph), addressed themselves exclusively to the recording of that strange phenomenon, the corona. To secure any impression from this object, which, notwithstanding its apparent brightness is remarkably deficient in photographic power, it was necessary to make a very small image, and to give a very long exposure.

The telescope was therefore arranged to produce an image in its principal focus simply, and during the totality an exposure of 40 seconds was given. By this means a picture was obtained, of which the accompanying cut is a very careful copy. From the long exposure and motion of the moon, as also, probably, of the light in the corona, there is little sharpness of definition,

* A careful examination of the photographs of the prominences on the eastern limb of the sun, upon which the slit of the spectroscope was directed during the first half of totality, somewhat diminishes my confidence in the conclusion of the text, as to the nature of these three lines. I think it absolutely certain that they do not belong to the spectrum of the *brilliant portion* of the prominences; but the photograph shows, in addition, an extensive nebulosity surrounding the nuclei, with a pretty definite boundary of its own. This nebulosity is best seen in No. 2 of the totality pictures taken at Burlington. Now, it is *possible* that these lines may belong to this *nebulosity*, and not to the *corona proper*; for I cannot recall, with certainty, whether the 1474 line retained its brilliance at any considerable distance from the prominences. My impression is that it did, and that the text is correct, but do not wish to be too positive. The eclipse of December, 1870, will decide, of course.

and the prominences only appear as bright spots. The general shape of the corona is, however, very well given, and the curious appearance of curvature, in some



parts, is very manifest. This and other pictures—if others than the one we have seen were made—may throw some light upon this extraordinary object.

ON RAISING A HIGHER TEMPERATURE IN CERTAIN SOLUTIONS BY STEAM OF 212° Fahr. (100° C.).

By PETER SPENCE, F.C.S.

Some twelve to fifteen years ago, the author had occasion to require large masses of liquor to be raised to a temperature of 228° F. (108·8° C.), for the purpose of extracting, by means of long-continued digestion at that heat, of alumina, in the form of sulphate of alumina, from minerals containing that earth. As time was an element of importance in his calculations, the author's aim was to heat the liquors as rapidly as possible; but lead vessels only could be used with the acid liquors; and, as it was requisite to have an iron outside vessel next the fire, the heating was a tedious operation. To overcome this loss of time, the author fitted up a digesting vessel, so as to raise the heat rapidly to 212° F. (100° C.), by injecting steam from a steam boiler into the mass of liquor; and as soon as he had obtained that temperature, he stopped off the steam, and allowed the external fire to operate alone, so as to raise the additional 16° F. (8·8° C.) required, and to maintain the temperature at 228° F. (108·8° C.), his impression being that, above 212° F. (100° C.), the steam, if kept on, would act as a cooling agent, and prevent the temperature rising. The combined operation was perfectly successful, and went on for some time, acting, as the author supposed, in accordance with his pre-conceived theory; but some circumstances led him, subsequently, to doubt whether it was so. He found that if, inadvertently, both steam and fire were left acting after the higher temperature was obtained, the temperature continued, notwithstanding. Again, when the fire was in a condition, through neglect, in which it was obviously of no use, the author was still astonished to find that, as the apparent result of the steam alone, the temperature was at a satisfactory point. This last observation led the author to test the matter in the laboratory in the following manner:—Being convinced that the high boiling point of his liquors had something to do with the phenomenon, he selected a solution of a salt (nitrate of soda) having a high boiling point—about 250° F. (121·1° C.). The nitrate of soda was placed in a vessel surrounded by a jacket; steam was let into the intervening space, until a temperature of nearly 212° F. (100° C.) was obtained; the steam was then shut off, and an open pipe immersed in the solution, and steam from the same source was thrown directly into the liquor; in a few seconds, the thermometer slowly, but steadily moved, and minute after minute progressed, until it touched 250° F. (121·1° C.). This thoroughly explained the results obtained in the digesting vessel, and became to the author of immense practical value. He discarded the use of fire applied to his vessels, which had not only been tedious and troublesome in operation, but involved a loss of many hundreds of pounds per annum in destruction of apparatus, and used only steam as a vehicle of heat. As a corroboration of the theory, which seems to explain the apparent paradox, the author finds that the temperatures of his solutions are in the exact ratios of their specific gravities, and have no connection with the temperature of the steam, which never exceeds 212° F. (100° C.). The greater the specific gravity of his acid solutions, the higher the boiling-point; and, therefore, whatever the boiling point of the solution in water of any salt, to that point, or nearly, will steam of 212° F. (100° C.) raise it.

ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 245.)

Next in importance to the possession of a good instrument, is the having a good supply of light and knowing how to make proper use of it. The sources of light available for the microscopist's use have already been described; the ways of utilising the light so obtained, and the instrumental appliances for directing it, form the subject of this chapter.

The natural division of illuminators is into two classes—those which act above the stage of the microscope, and send light down upon an object; and those which are placed below the stage, and send light through it.

Of instruments of the first class, one—the *condensing lens*—is usually supplied with every microscope, however plainly equipped. This lens enables light to be concentrated upon the object on the stage; either a double-convex or a plano-convex lens may be used for this purpose. If the first is employed, no particular attention is required beyond placing it at such a distance above, and on one side of the stage, that the light falls at a suitable angle, and that the object is in or near the focus: should a plano-convex lens be used, its position is of some importance, as, if it is turned the wrong way, its spherical aberration is greatly increased, and, of course, a corresponding amount of light lost. The plano-convex lens, or bull's-eye, when used to concentrate parallel rays—daylight, for instance—or divergent rays, such as those proceeding from a lamp, should always be placed with its convex side turned towards the source of light, as the spherical aberration is then much less than it would be when placed in the contrary direction; if the lens is to be used for rendering parallel the divergent rays of a lamp, then the bull's-eye is to be placed in the opposite position, with its flat side turned to the lamp, and at a distance from the flame equal to its focal length. Parallel rays are required when using some of the illuminating apparatus presently to be described.

Very much may be done with the condensing lens, if skilfully used; especial care is required that it

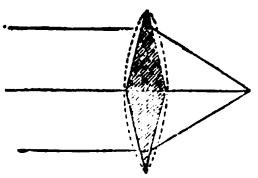
* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

causes the light to fall on the object in the right direction, as the appearance of the surface of many substances is very different when illuminated from opposite sides; the student should, therefore, never be contented with a single observation of a strange substance, but should change its position, so that it may be viewed with the light falling upon it in as many directions as possible. This is most easily effected by causing the object to rotate while the light is directed upon it, so that the alteration caused by every change of position can be easily noted. The necessary movement is now very generally fitted, even to the stages of small instruments, and persons about to procure a microscope would do well to incur the small extra cost of this useful addition.

The light obtained by the condensing lens may be greatly augmented by using two, one of larger dimensions than the other, the light being brought to a certain degree of convergence by the first and larger lens, and afterwards concentrated by passing through the smaller one, which should be so placed as to intercept the cone of light from the large lens at the place where it is of its own diameter.

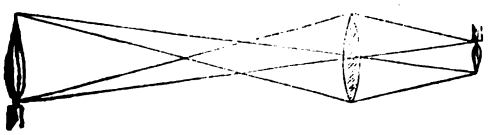
Most of the other illuminators of this class act by reflection, mirrors of various forms being employed. The optical properties of concave mirrors resemble, in many points, those of convex lenses; they cause parallel rays to converge (Fig. 19), render divergent

Fig. 19.



rays parallel, or convergent, and also form images (Fig. 20). Microscopes and telescopes can be con-

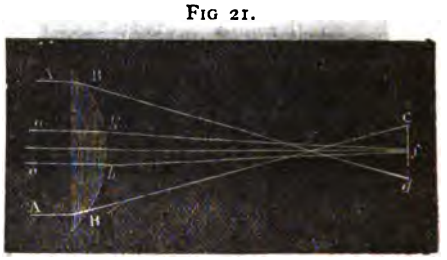
Fig. 20.



structed with mirrors or specula, instead of object-glasses; this principle is still in use as regards telescopes of large dimensions, as the difficulties of making object-glasses of large diameter are very great; the largest yet accomplished is only 25 inches, while the largest speculum (that of the late Lord Rosse) is 6 feet in diameter.

Professor Amici constructed a very efficient compound microscope, having an elliptical speculum in place of an object-glass; the plan, however, was abandoned on the introduction of the achromatic principle, although its performances were very superior to those of the non-achromatic instrument.* Concave mirrors, when formed of segments of spheres, are liable to spherical aberration, just as lenses are (Fig. 21); therefore, when it is required to render divergent rays parallel, or bring parallel rays to a focus, it is necessary that the figure of the mirror should be that of a parabola. Specula of this form are used in astronomical telescopes, the reflectors of lighthouses on the catoptric principle, and in some instruments presently to be described. The parabolic curve differs from the circle principally in being flatter at the edges and deeper at the centre. Reflecting instruments are entirely free

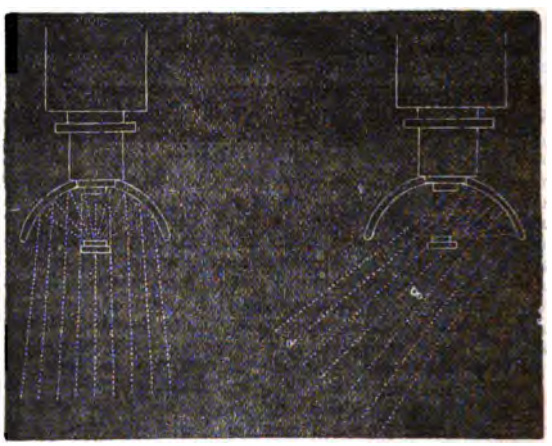
Fig 21.



from chromatic aberration. The oldest of the reflecting illuminators is that known, from the name of its inventor, as the *Lieberkuhn* (Fig. 22); it consists

Fig. 22.

A B



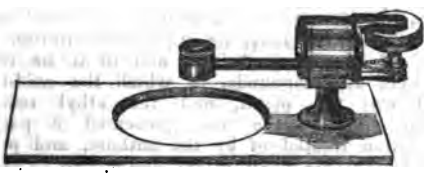
of a spherical silver mirror, perforated, to allow it to slide over the setting of the object-glass, and is so adjusted that the focus of the speculum is coincident with the working distance of the object-glass. The object is illuminated by light reflected through the hole in the stage by means of the mirror; this is again reflected, but in a very convergent state, upon the object, which will be intensely illuminated if the speculum is well adjusted to focus and properly supplied with light.

It is necessary to place beneath the object a black stop of sufficient size to fill the field of the object glass, otherwise the light from beneath entering the microscope will cause a disagreeable amount of fog and indistinctness. The best kind of background consists of a dark well or little cup of proper size painted black inside, and placed below the object; a patch of black paper or paint will, however, answer the purpose. Beck's disc holder (Fig. 23) is particularly useful for objects to be examined by the aid of the lieberkuhn, as it forms its own black stop. Its late talented inventor was very expert in the employment of this kind of illumination. The defects of the lieberkuhn are that its light is nearly vertical, and therefore, like the tropical mid-day

* One of these instruments has recently been presented to the Royal Microspocical Society; there are also several old and curious microscopes in the Society's collection.

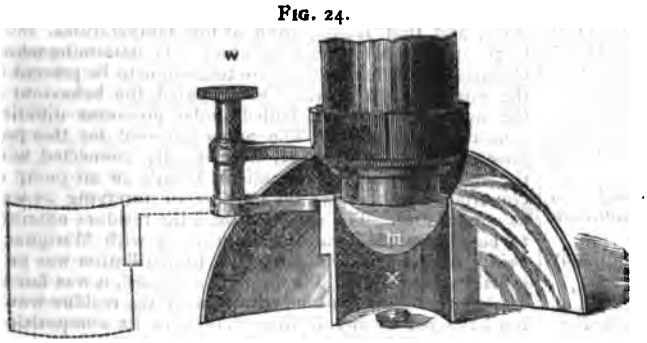
sun, casts little or no shadow; this, however, may be remedied, to some extent, by turning the mirror aside and using the light from only one-half of the speculum (Fig. 22, B); also it requires the object and its mounting to be small enough to allow the free passage of the light around it from the mirror.

FIG. 23.



These defects caused the lieberkuhn to fall somewhat into disuse; the introduction of the binocular microscope, however, caused it again to be employed, as it was found very suitable for the peculiar class of opaque objects which are so well displayed in relief by its stereoscopic power. It has, however, again been nearly superseded by an improved form, which has all its advantages besides some peculiar to itself. This improved instrument, which is known as the *parabolic lieberkuhn* (Fig. 24), is another of the

FIG. 24.



numerous contrivances of the late Richard Beck, and was described by him in the *Microscopical Quarterly Journal* for 1865 (vol. xiii., p. 116). It consists of a portion of a silvered paraboloid, which is attached by a ring to the setting of the object-glass, so that it has some range of adjustment like the ordinary lieberkuhn, but instead of the light being directed upon it from below through the hole in the stage, it is supplied from one side, which allows this form of lieberkuhn to be used with objects mounted in the ordinary way. It is necessary when lamp light is used that the rays should be rendered parallel by placing a condensing lens between the lamp and the reflector, as before-mentioned. As there is a very large reflecting surface, and from the parabolic figure of the mirror no spherical aberration, the amount of light concentrated upon the object is much greater than could be obtained from the ordinary spherical lieberkuhn. It has also the advantage of reflecting rays from one side only and of considerable obliquity. These properties make it the most perfect illuminator yet produced for viewing opaque objects by reflected light. Its effect is almost like that of brilliant sunshine, lighting up the interior of every cavity, and yet, at the same time, casting strong shadows and defining minute portions of structure in a manner hitherto unapproached. The paraboloid as usually constructed is adapted for use with objectives of from 2 inches to ⅛ focus. A very ingenious mounting, allowing a very large range of adjustment to be given to the paraboloid, has been contrived by Mr. Crouch, who uses a short adapter screwed into the body of the microscope as a support to the reflector and its fittings, which consists of sliding tubes and ball-and-socket joints, by means of which it can be placed in extremely varied positions, and is adapted for use with any microscope or object-glass fitted with the universal screw. It must be borne in mind that these advantages are gained at the expense of removing the object-glass a small distance, viz., the length of the adapter from the Wenham prism, while, to obtain the best possible definition, the back lens of the objective cannot approach the prism too closely; therefore in making choice between the two forms of mounting the paraboloid, the student must consider whether convenience with a trifling loss of definition will suit him, or whether the most perfect definition is required with the trifling inconvenience attending the ordinary form.

An addition to the parabolic lieberkuhn, consisting of a small plane mirror (Fig. 24, *m*) inclined at an angle of 45°, which is so fitted that it can be brought into the proper position for reflecting light vertically upon the object, by means of the milled head, w, has been made by Messrs. Beck, at the suggestion of Mr. Sorby, who required this contrivance for viewing the polished surfaces of specimens of iron and steel. When light is directed obliquely upon a highly polished surface, it is reflected at an angle equal to the angle of incidence, none of it enters the microscope, and the surface appears intensely black, but when illuminated vertically, all its structural peculiarities are at once brought into view. For such researches the plane speculum is indispensable, and its adaptation in no way interferes with the ordinary use of the paraboloid.

The late Richard Beck made a small paraboloid, adapted for use with the 4-10th objective. This the author had an opportunity of working with, and, although only in experimental condition, was much pleased with its performance. It was returned after trial, but has not at present been produced for sale by Messrs. Beck, probably on account of its value not being generally known. From its very short focus, it requires much more careful fitting to the objective it is intended to be used with than the larger paraboloid; but when carefully executed, it works quite as well with its own object-glass as the one above mentioned with the lower powers. The author, however, possesses one which was made for him by Mr. Bailey, of 162, Fenchurch Street, which performs admirably, and is executed in this optician's usual careful manner. The parabolic lieberkuhn is of great value with ½ inch and 4-10th objectives, as these glasses allow but little space between the front glass and the object for illumination with the condensing lens.

A very efficient illuminator was, until recently, much in use; it is known as the *side reflector*, and consists of an oblong silvered mirror of spherical figure. It has ball-and-socket and sliding adjustments, and is attached either to the stand of the microscope or else is mounted upon an independent support; it is placed on one side of the instrument,

and the light directed upon it from the opposite side. The speculum is then adjusted until the object is properly illuminated. It has, however, been superseded by the parabolic lieberkuhn before described.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 18th, 1869.

Dr. A. W. Williamson, F.R.S., &c., President, in the Chair.

The minutes of the previous meeting having been read and confirmed, the following certificates were read:—

For the first time—Samuel Jefferson, Secretary to the Yorkshire Board of Education, Woodville Terrace, Woodhouse Lane, Leeds; Clements Higgins, Demonstrator of Chemistry, King's College, London; James John Bourey, Analytical Chemist, 10, Stepney Causeway, E.

For the second time—Matthew H. Cochrane, 108, Paul Terrace, Glasgow; Edward Smith, Practical and Pharmaceutical Chemist, Strand, Torquay; Thomas Walton, M.R.C.S., and L.S.A., Lecturer on Chemistry at the Hull and East Riding School of Medicine, Kingston-upon-Hull; G. Manley Hopwood, 22, Grosvenor Square, All Saints, Manchester; John Wiggin, Pharmaceutical and Analytical Chemist, Ipswich; Thomas Gibb, A.R.S.M., Engineer; George Harrison, Analytical Chemist, 26, Havelock Square, Sheffield; Sir Roderick Impey Murchison, Bart., F.R.S., Belgrave Square.

For the third time—E. S. Blackwell, Analytical and Consulting Chemist, 6, St. Sacrament Street, Montreal, Canada.

The last-named gentleman was ballotted for and duly elected.

At the request of the President, a paper by William Dittmar, F.R.S.E., and George Cranston, "*On the Formation of Carbonic Ether*," was read by the Secretary.

The authors referred to Ettling's researches upon the action of sodium or potassium on oxalate of ethyl, and had endeavoured to discover the *rationale* of that action. They found that, when ready-formed sodium ethylate (ENaO) is brought into contact with oxalate of ethyl, the former compound, like the metal itself, causes the formation of carbonic ether and carbonic oxide. Dry ethylate (ENaO) was prepared by evaporating the liquid alcoholate in a current of dry hydrogen in a retort heated in an oil-bath, when the compound remained as a white porous mass. On treating dry ethylate with about eight times its weight of oxalic ether, it dissolves, and a yellowish syrup is formed, which sometimes gelatinises on standing. If this mixture is gradually heated, at about 80° C. large quantities of gas (chiefly carbonic oxide) are evolved, and the mass darkens till it is almost black. At 140° the reaction ceases. The mass is then distilled at a temperature not exceeding 200°; and the distillate consists of carbonate of ethyl, sometimes mixed with undecomposed oxalate, and always contaminated with ethylic alcohol. The black residue dissolves in water, and contains oxalate and formiate of soda, and also the soda salts of some complex organic acids. Experiments in order to obtain a basis for the speculation on the nature of the reaction led to the following conclusions:—"ENaO" parts of ethylate, acting upon an excess of oxalic ether, decompose 4 "$(EO)_2C_2O_2$" parts of oxalate of ethyl, and produce 3 "$(EO)_2CO$" parts of carbonate of ethyl, 3 "CO" parts of carbonic oxide, and about 0·4 "EHO" parts of alcohol. The behaviour of dry ethylate of potassium on oxalate of ethyl was qualitatively analogous to that of sodium ethylate; the reaction is, however, more energetic, and begins at a lower temperature.

The President said they were indebted to the authors for their interesting communication. It was remarkable that those bodies should effect the same decomposition as had been observed with the metals themselves; and he hoped the authors would follow up the reactions, so as to show the phases of which they consisted.

Professor Wanklyn said that he had read a paper to the Society in 1864, on "The Constitution of the Ethers of the Fatty Acids," and in it he regarded the ethers as compounds, in which the acid-forming radical was the metal, and the ethyl oxide the chlorous radical. He also presented a paper on the reaction treated of by the authors, and predicted that ethylate of sodium would decompose oxalic ether, and produce carbonic oxide and a carbonic ether, and that an unlimited quantity of oxalic ether might be decomposed by a given quantity of ethylate of sodium; but the paper was not published by the Society. It was gratifying to him to find his prediction verified so long afterwards by gentlemen who had made the experiment without any communication with, and quite independently of, himself.

"*On the Dissociation of Liquid Sulphuric Acid*," by W. Dittmar, F.R.S.E., was then read.

In the opinion of the author, the experiments of Marignac on this subject seemed to show that "H_2SO_4" exists as a definite chemical individual only in the solid state, and that H_2SO_4, even at low temperatures, must be regarded as a molecular mixture. To determine which chemical individuals they were to assume to be present in the mixture, Mr. Dittmar investigated the behaviour of the acid H_2SO_4 when boiled under pressures differing from the atmosphere. The apparatus used for this purpose consisted of a retort, hermetically connected with the receiver, which communicated with an air-pump so constructed as to serve the purpose of rarefying as well as condensing. The results proved the residues obtained to be almost identical in composition with Marignac's acid. As the acid first subjected to distillation was only a little stronger than the product obtained, it was fair to assume that a further concentration of the residue would not have led to any further change in its composition. Sulphuric acid, when boiled down under any pressure between 3 c.m. and 314 c.m., behaves almost like a mixture of the stable hydrate $12SO_3 13H_2O$ + excess of SO_3, but the existence of a stable *molecule* of this composition could not be deduced from this fact. The observed facts could be accounted for without denying that in liquid sulphuric acid, even at its boiling point, the majority of the molecules have the composition H_2SO_4. It was known that 'H_2SO_4' vapour consists chiefly of isolated molecules of SO_3 and H_2O; and it was in accordance with Clausius's theory to assume that in liquid sulphuric acid, even at low temperatures, a number of the molecules have assumed the state of motion corresponding to a temperature beyond that of dissociation. The higher the temperature, the greater the ratio of the number of the dissociated molecules to that of the unchanged ones. The liberated H_2O's and SO_3's being formed in the midst of a mass of (H_2SO_4)'s will, probably, mostly unite with comparatively cold molecules of H_2SO_4, and form compounds $H_2SO_4 + H_2O$ and $H_2SO_4 + SO_3$ respectively; supposing the latter compound to be less stable than the former, it is easily understood that, in the distillation of sulphuric acid, the higher the temperature, the more SO_3 will predominate in the vapour.

Professor A. H. Church, M.A., then read a communication on "*Namaqualite*." This mineral occurs in Namaqualand, South Africa, in thin layers of silky fibres, which are true crystals. It is of a pale blue colour; its density is 2·49. Isolated crystals appear transparent under the microscope. In the closed tube it gives off much water, when heated becoming black. The mean per-

centages deduced from the analysis of five specimens are as follows:—

H_2O	32·38
CuO	44·74
Al_2O_3	15·29
CaO	2·01
MgO	3·42
SiO_2	2·25
	100·09

Regarding the silica as an intruding substance, and the lime and magnesia as replacing a small part of the cupric oxide, the author thought the mineral might reasonably be considered as a compound of 4 molecules of cupric hydrate, 1 molecule of aluminium hydrate, and 4 molecules of water. The oxygen ratio between the protoxides, the aluminium oxide, and the water, is 4:3:11 nearly, and corresponds to such a view. The mineral belongs to the rare class of hydrous oxides, in which a protoxide and sesquioxide are united. The fact that it is crystallised, as well as definite and constant in composition, demands for it specific rank.

"*Chemical Researches on New and Rare Cornish Minerals (No. 6)—Hisingerite,*" by Prof. CHURCH, M.A. Under this name the author provisionally describes a brown amorphous mineral found in Cornwall. Its chief characteristics are as follows:—Amorphous; reniform; fissured; dark brown; streak, pale; rust, brown (in some specimens, olive-brown); Fragile; fracture, irregular conchoidal; hardness, 2·75; density, 1·74. Before blowpipe in closed tube much water, having faint permanent acid reaction. On charcoal, decrepitates and becomes black. Fuses with difficulty in outer flame to a red brown bead. Boiled in acids leaves a siliceous skeleton.

The mean percentages deduced from three analyses run thus:—

Fe_2O_3	52·94
SiO_2	36·14
H_2O	10·49
	99·57

The mineral also contained 0·82 per cent of P_2O_5 and traces of magnesia.

"*On Chloranil and Bromanil*" (No. II.*), by Dr. STENHOUSE, LL.D., F.R.S., &c.

When phenol was acted upon by chloride of iodine in the presence of water, it yielded a brown crystalline mass, from which chloranil was obtained. Red oil, obtained in the ordinary process for preparing chloranil, dissolved in a dilute boiling solution of caustic soda, a sufficient quantity of potassic chlorate, and hydrochloric acid, yielded small crystalline scales, consisting of chloranil and terchlorquinone. When the red oil was digested with nitric acid, sp. gr. 1·36, red fumes took place. Chloropicrin distilled over; chloranil remaining in the retort.

Chloranilic Acid was prepared as follows:—Five parts of chloranil, moistened with alcohol, were added to a cold solution of 6 parts of potassic hydrate in 150 of water; the mixture occasionally stirred till the yellow scales disappeared and part of the potassium salt had crystallised out in dark red needles. The chloranilic salt is precipitated by adding from 10 to 15 parts of chloride of sodium; it is then washed with a solution of common salt, and purified by one or two solutions in boiling water, precipitations by common salt, and a final crystallisation from distilled water. The chloranilate is then dissolved in 100 parts of boiling water, and 10 parts of hydrochloric acid is added; on cooling, the chloranilic acid is deposited.

The alkaline chloranilates are prepared by neutralising pure chloranilic acid with the corresponding alkaline hydrate or carbonate.

Chloranilic ether, $C_6Cl_2(C_2H_5)_2O_4$.—One part of chloranilate of silver is digested with five of ethylic iodide until the silver salt is converted into iodide, the excess of iodide of ethyl distilled off, and the chloranilic ether extracted by boiling alcohol.

The action of chloride of iodine on chloranilic acid gave large transparent plates, which were found to be oxalic acid, and a heavy oily layer, which the author is at present investigating. The author is also investigating the action of bromine on chloranilic acid; he has already obtained a substance corresponding closely to $C_6Br_8Cl_3HO$.

Bromanil.—To prepare this substance, Dr. Stenhouse places bromine in a flask with one-third of its weight of iodine and five times its weight of cold water. On adding phenol through a long digestion tube, a strong reaction takes place; the phenol adhering to the side of the tube is then washed down with five parts more boiling water, and the whole digested for one or two hours at 100° C. When cold, the semi-solid contents are freed from the mother liquor with a Bunsen's vacuum filter, and digested with bisulphide of carbon to remove terbromophenic acid. Tolerably pure bromanil remains.

When bromanil was digested with hydriodic acid and phosphorus, bromhydranil, $C_6Br_4O_2H_2$, was obtained. The author also procured terbromhydroquinone and terbromquinone from the action of sulphurous acid on bromanil.

Bromanilic acid was prepared in a similar manner to chloranilic acid.

Bromanil phenylamid was prepared by adding an excess of aniline to bromanil dissolved in benzol, and washing the almost black crystalline plates with boiling alcohol.

The author concludes with an account of the action of bromine on bromanilic acid.

The PRESIDENT, in thanking Dr. Stenhouse for his interesting communication, referred to the beautiful specimens of some of the compounds described which had been sent to the Society by Dr. Stenhouse.

"*On the Salts of Acetylinated Ethyl,*" by J. ALFRED WANKLYN.

The liquids having the empirical formulæ $C_6H_{10}O_3$, $C_8H_{14}O_3$, and $C_{10}H_{18}O_3$, respectively, and which were discovered by Geuther, and Frankland and Duppa in the course of their researches on acetic ether, and to which a variety of names have been assigned by their discoverers, have been found to be, in reality, the salts of the new organic radical, "acetylinated ethyl." They show two characteristic reactions—With ethylate of sodium they yield salts of common ethyl, the acetyl being exchanged for hydrogen, thus:—

Butyrate of acetylinated ethyl.

$$\overbrace{\left.\begin{matrix}C_2H_4(C_2H_3O)\\C_4H_7O\end{matrix}\right\}O}+\left\{\begin{matrix}C_2H_4Na\\H\end{matrix}\right\}O=\left\{\begin{matrix}C_2H_5\\C_4H_7O\end{matrix}\right\}O+$$
$$+\left\{\begin{matrix}C_2H_4Na\\C_2H_3O\end{matrix}\right\}O$$

With baryta water, they give alcohol, a ketone, and carbonate of baryta—

$$\left.\begin{matrix}C_2H_4(C_2H_3O)\\C_4H_7O\end{matrix}\right\}O+\left\{\begin{matrix}Ba\\H_2\end{matrix}\right\}O_2=\left\{\begin{matrix}C_2H_4H\\H\end{matrix}\right\}O+$$
$$+\left\{\begin{matrix}C_2H_3O\\C_3H_7\end{matrix}\right\}+\left\{\begin{matrix}Ba\\CO\end{matrix}\right\}O_2,$$

wherein H_2 replaces acetyl and butyryl, and the latter do not form acetate and butyrate of baryta, but a ketone and carbonate of baryta, being an example of the common method of producing ketones, but at the temperature of the water-bath instead of at a low red-heat.

The Society then adjourned till Thursday, December 2nd.

We have received the following letter from Professor Wanklyn, respecting his researches on the subject of Messrs. Dittmar and Cranston's memoir:—

* For the author's first paper on this subject, see CHEMICAL NEWS, vol. xvii., p. 129.

To the Editor of the Chemical News.

Sir,—The paper suppressed by the Chemical Society in the year 1864, to which reference was made in the course of the discussion of Mr. Dittmar's admirable research "On the Production of Carbonic Ether," was a short note on that subject, and was intended to form an appendix to my paper "On the Constitution of the Ethers." In this note, I expressed the belief that the production of carbonic ether was due to the action of ethylate of sodium on oxalic ether, and that the reaction would be found to belong to the class of so-called catalytic actions. These predictions were made avowedly in virtue of the general views of the structure of the ethers which were then entertained by me, and were, in my opinion, useful as tests of the validity of those theories, and also as illustrative of their nature and meaning. The authorities of the Society, however, appear to have entertained a different opinion, and, out of a tender regard for my reputation as a chemist, suppressed the note.

On referring to the report in the Chemical News (vol. x., p. 233), I find the following passage at the end of the abstract of my paper on the ethers:—"An explanation of the formation of carbonic ether from oxalic ether was also given." The note itself has, I believe, never been published, but was referred to by me in a paper "On Formic Ether" (see Chemical News, vol. xvii., p. 144).

At that period, I was unprepared for such an exercise of paternal solicitude on the part of the officers of the Society, and took no steps to avoid suppression. In more recent times, I have always been in readiness to resist dictation of this sort, and, though frequent attempts have been made on the part of the Society to suppress papers either of my own or of my former colleagues, have never submitted to the smallest suppression. The practical result has been that which might have been anticipated, viz., the scattering of my papers through different journals; and, if chemists should hereafter complain that what I have written on a given chemical subject is not all of it to be found in the pages of the *Chemical Society's Journal*, but is diffused through the scientific press, the fault lies with the officials of the Society, and not with me.—I am, &c.,

J. Alfred Wanklyn,
Corresponding Member of the Royal Bavarian Academy of Sciences.

London, Nov. 20th, 1869.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

A meeting was held on Monday evening, the 22nd inst., Dr. Wallace, F.R.S.E., Vice-President, in the chair.

The following four gentlemen were elected Members of Council, in room of four who retired by rotation:—James Anderson, Esq., 98, St. Vincent Street; Dr. John Clark, Anderson's University Laboratory; James Couper, Esq., St. Rollox Chemical Works; P. M. Moir, Esq.

Dr. Wallace then made some remarks on the results of his examinations of some waters taken from cisterns in the vicinity of water-closets, in various parts of Glasgow. He stated that the results of his observations, which were made conjointly with Dr. Anderson, went to show that there was not a trace of any gas present which could arise from the decomposition of animal matter. A microscopic examination did not show the presence of any insoluble matters other than ordinary dust.

A new and very different source of danger, however, was revealed by the analyses. It was found that water which had got warm by remaining in pipes which were exposed to warmth, either by proximity to the usual hot-water pipes or otherwise, was frequently contaminated with lead to such an extent as to render the use of the water for dietetic purposes positively dangerous.

NOTICES OF BOOKS.

Outlines of Chemistry, or Brief Notes of Chemical Facts. By William Odling, M.B., F.R.S., Fullerian Professor of Chemistry at the Royal Institution. London: Longmans, Green, and Co. 1870. 8vo.; 468 pp.

This work consists of detail notes of the lectures which Dr. Odling has been in the habit of giving at St. Bartholomew's Hospital during the last seven years; of such notes, in fact, as are now frequently printed separately and distributed among an audience. It is much to be wished that this plan (which, if we remember rightly, was first introduced at the Royal Institution in 1862) was more often followed, as it must perforce give the listener a clearer idea of the lecture than he could otherwise have, while it prevents his attention from being diverted by the writing of notes. A lecture, after all, is chiefly for puposes of demonstration, and experiments are too often lost by the student who is desirous of making full notes; it is, moreover, always essential that numbers and complex formulæ should appear in other forms than as a momentary utterance or on the black-board. This book is virtually a collection of lecture-notes; and the main object of the author was "to furnish the students of St. Bartholomew's with an abstract" of his lectures. Of necessity, such a collection of notes must form "*outlines* of chemistry;" it is as a picture with all the broad details of design introduced, but without the filling-in and finishing. It is not intended to be used by itself, "but as a companion to the teachings of the lecture-room, and as an aid to the appreciation of more complete works, such as Miller's "Elements" and Watts's "Dictionary."

The work is divided into twelve chapters, the first whereof, although introductory, plunges into the middle of things, and treats of the law of volumes, equivalency, heat of combination, and so forth, and of some of the more complex questions of classification. Thus, in the section on "Acids and Salts," we find such paragraphs as the following:—"Mono-, tri-, and penta- equivalency of same perissad element as nitrogen, in different compounds as N'_2O, H_3N''', and $ClH_4\overset{v}{N}$? Di-, tetra-, and hexa- equivalency of same artiad element as sulphur, in Cl_2S'', $Cl_2S''''O$, and $S''''O_2$, and $Cl_2\overset{vi}{S}O_2$, and $\overset{vi}{S}O_3$? Persistency of different equivalent values in double decomposition, as of stannous and stannic salts by lime—

$$Cl_2Sn'' + CaO = Cl_2Ca + Sn''O$$
$$Cl_4Sn'''' + 2CaO = 2Cl_2Ca + Sn''''O_2$$

Theoretical views concerning change of equivalency, real or apparent. Hypo- and hyper- saturated compounds, saturation by one another of two equivalencies of same atom (?)." Useful sections on the "Formula of Water," and on "The Heat of Combination," are found at the end of this chapter.

The second chapter treats of hydrogen and of the halogen elements, and the third of the oxygen elements. In the latter, the sulphur acids are discussed at some length, and the various actions of sulphuric acid on metals, oxides, and salts are illustrated very concisely by five reactions, in which, by the interchange of hydrogen for metal, we have sulphurous acid liberated when the strong acid acts upon metals; hydrogen when the weak acid acts upon more basylous metals; water or sulphydric acid when the acid acts upon oxides or sulphides; water and oxygen when it acts upon peroxides; and acids when it decomposes salts. This sort of classification of the action of one substance upon others of varied composition is of great use in fixing the separate qualities of a chemical substance in the mind of the student. In each case, we have one constant and two variants, but each variant is the type of a class, and thus the changes become grouped within comparatively narrow limits. The system of types and of analogies is carried out to the fullest extent;

on every possible occasion, related substances are compared; such we have in the list of the "oxides of hydrochloric acid, sulphuretted hydrogen, and phosphine" (p. 65). These expressions will appear strange to some of us, but Dr. Odling does not bind himself to any one name; thus H_3PO_4 is both an oxide of phosphine and ortho-phosphoric acid; $HClO_4$ is an oxide of hydrochloric acid and perchloric acid. In the above comparison, they are obviously called oxides of hydrochloric acid, sulphuretted hydrogen, and phosphine, because the compounds are similarly oxygenated, the HCl, H_2S, and H_3P being found in each compound of its respective series.

Chapter 5 treats of the carbon elements, and extends over nearly a hundred pages. To this group belong carbon, silicon, tin, and lead, a grouping which is founded on the tetrad character of these elements, as indicated by their combination with hydrogen, ethyl, fluorine, and chlorine. In the account of silicon, the terms *Siliconides* and *Siliconetted hydrogen* are employed. It is certainly surprising how such a word as "siliciuretted hydrogen" came to be introduced into chemistry, but it was undoubtedly made in agreement with such words as carburetted, sulphuretted, phosphuretted, &c. Nearly the whole of this chapter is devoted to carbon and monocarbon compounds. These are divided into three groups; viz., the methylic typified by H_4C, the formic typified by formic aldehyde, H_2CO'', and the cyanic typified by hydrocyanic acid, HCN'''.

Chapter 6 gives a description of the Sodium Elements—sodium, lithium, silver, potassium, rubidium, cæsium. With these monad metals are considered the triad metals, thallium and gold, "on account of their each forming a series of monad compounds corresponding to those of potassium and silver." The group of magnesium elements consists of calcium, strontium, barium, beryllium, magnesium, zinc, cadmium, and mercury; and these are distinguished by replacing the hydrogen of hydrochloric acid in the proportion of one atom of the metal to two atoms of hydrogen.

The remaining chapters treat of the other groups of metals; to wit, the Tin Elements—aluminium, tin, didymium, thorium, and indium; the Arsenic Elements—titanium, zirconium, cerium, yttrium, erbium, lanthanum, arsenic, antimony, bismuth, vanadium, niobium, and tantalum; the Chromium Elements—chromium, molybdenum, and tungsten; the Iron Elements—manganese, iron, cobalt, nickel, copper, and uranium; and the Platinum Metals—palladium, platinum, rhodium, iridium, ruthenium, and osmium.

One of the most prominent features of this work, as of all Dr. Odling's works, is the constant attempt to classify—to collect together compounds which, however much they may differ in some respects, have at least one cardinal and prominent resemblance; and, in such classifications, he has wisely exercised his judgment in deciding which kind of resemblance shall determine the grouping of diverse bodies. This must ever be a matter of difference of opinion among chemists, although, for the good of the science, it is much to be wished that an universal mode of classification should obtain throughout the chemical world. The section on *Equivalency* in the first chapter treats specially of the modes of classification; the primary hydrides into mono-, di-, tri-, and tetra-hydrides; and so with chlorides, &c. Then the division of the elements into monads, diads, triads, and tetrads, and into artiads and perissads.

The derivation and explanation of terms, and the arguments in favour of the applicability of some in preference to others, is left to more detail works on chemistry; as, also, is any account of manipulation, and of the preparation of the various simple and compound substances described. This is by no means an elementary work. It is best fitted for the teacher and for advanced pupils; to those who are engaged in the delivery of long courses of lectures it will be invaluable. It is eminently methodical and systematic; if chemistry could ever be what Dr. Whewell calls "a classificatory science," Dr. Odling would be the man to make it so. The very nature of this work makes it *staccato* in character; and, since we have gone to music for a word, we may also say it is entirely free from *appogiature*. There is not a word too much; every sentence is sharp, precise, and to the point; it is a *précis* rather than a finished treatise. It reminds us of a map in which the principal cities and towns are introduced, while the villages are omitted. Compared with a detail "handbook" or "cours de chimie," it is as M. Logerot's "Souvenir du Nouveau Paris" compared with Fielding's map of that city.

Dr. Odling does not employ one form of phraseology; he appears, indeed, rather to prefer to vary the names of a substance as much as possible. He uses such names as cupric nitrate and zinc chloride "indifferently and alternatively" with nitrate of copper and chloride of zinc. The fact is, we are not to say of chemical compounds "by their names shall ye know them;" we must be so familiar with their nature and composition that we shall know them under any reasonable designation whatsoever. It is thus with friends; at first the name is the entity; while, on better acquaintance, the individuality of the entity manifests itself, and we know him and remember him for his character and qualities, the name in its first form of significance having of necessity vanished. It is thus, also, we suspect, that Dr. Odling wishes us to treat chemical compounds. Thus viewed, such terms as "oxide of hydrochloric acid," "nitro-marsh-gas," and "hydro-sodium-carbonate," grate less upon the ear than would otherwise be the case: it is familiarity with the compound designated which is to level the barrier of names. If our friend A. B. chooses to change his name to X. Y., he is the same to us, but to a possible future friend, Z., he virtually becomes another being, because Z. knew him not before the change. Similarly, if we are familiar with the composition of the body HCN''', we may call it, "indifferently and alternatively," prussic acid, or hydrocyanic acid, or nitro-marsh-gas, or cyanic hydride; but, to the neophyte, the matter will appear in a very different light. "What's in a name?" Ask the gentleman who whilom bore the name of *Cimex Lectularius*, or that other one (whose name we also prefer to Latinise) who recently wrote to the *Times* complaining of the adverse influence of his name upon his daughter's matrimonial prospects; and no wonder, for he was called *Johannes Curtacola*. Modern chemistry does not allow her children to have fancies of this sort. In all seriousness, our science does contain a marvellous medley of names, derived from the most varied sources—Hebrew, Greek, Latin, Arabic, Spanish, Old High German, and Low Latin, combine to mystify and perplex the student.

Let us now justify our remarks as to the general character and the extreme conciseness of this work by giving one or two extracts taken at random.

"Methene, H_4C, obtainable from methyl alcohol, H_4CO, through intervention of methyl chloride, iodide, &c., by action thereupon of nascent hydrogen; from formic acid, H_2CO_2, by its transmission over ignited baryta; and from disulphide of carbon, CS_2, the sulpho-derivative of carbanhydride, by its joint reaction with sulphuretted hydrogen upon ignited metallic copper."

Again, in the account of the hydrocyanic and cyanic ethers, we find concise, comprehensive statements of the following nature:—

"β-cyanide of methyl unknown. β-cyanide of ethyl made by reaction of cyanide of silver and iodide of ethyl in sealed tubes—$IH_5C_2 + AgCN = AgI + H_5C_2CN$; also by action of chloroform on ethylamine, in presence of potash—$HCl_3C + H_2(H_5C_2)N = 3HCl + H_5C_2.CN$. Resistance of this cyanide to action of alkalies. Its immediate decomposition, with absorption of water, under the influence of acids, into formic acid and ethylamine—

$$H_5C_2.CN + 2H_2O = H_2CO_2 + H_2(H_5C_2)N.$$

Throughout, Dr. Odling has employed names which indicate the relationship of bodies to each other rather than

their absolute composition. "For example," he says, "although I have no doubt whatever that corrosive sublimate is really a dichloride of mercury, there was a time when I was equally certain of its being a monochloride; and, taught by this experience, I now prefer to distinguish it by the name 'mercuric chloride,' and calomel by the name 'mercurous chloride;' whereby I merely imply, what never has been a matter of question, that the ratio of chlorine to mercury is greater in the one compound than in the other." As a consequence of this method, it happens that bodies differently constituted have similarly constructed names; thus CuO, Fe_2O_3, and SnO_2, are cupric, ferric, and stannic oxides respectively. Dr. Odling has carefully avoided the use of any method of graphic notation: "It has," he remarks, "I believe, exerted, and still continues to exert, a most prejudicial influence on the study of chemical science, by making the fanciful sticking together of variously-pronged discs of more importance than the investigation of phenomena." Again, he has not expressed reactions molecularly, because, as he candidly remarks, "In the majority of reactions, I do not myself know what the molecular formulæ of the reagents and products concerned are, and do not think it worth while to make a pretence of knowing."

Now, we have been wont to regard Dr. Odling as the extremest radical in the world of chemists—indeed, as a sort of revolutionary red republican; and we rejoice to find him taking an intermediate course, leaving extreme views to the Raspails and Rocheforts of our science. There is no denying the fact that the science has progressed so rapidly of late that the prominent attitude of chemical thought is generalisation; facts have accumulated in such an astounding manner as the army of workers has increased that the desire of collecting particulars has, in many cases, been replaced by the desire of generalising upon the knowledge already attained. The temptation is, indeed, strong, but the science is not yet ripe for such a process. Certain chemists, seeing a little light in the distance, are hallooing before they are out of the wood. They may spare their voices yet awhile, and had better seek for the path which shall lead others from the gloom hereafter. We pray them to bear in mind Plato's exquisite parable of the dim cave, full of shadows which come and go; and to remember that there are two ways of investigating and discovering truth, to the first of which many have attached themselves. "*Altera a sensu et particularibus advolat ad axiomata maxime generalia atque ex iis principiis eorumque immota veritate judicat et invenit axiomata media. . . Altera a sensu et particularibus excitat axiomata*, ascendendo continenter et gradatim, *ut ultimo loco perveniatur ad maxime generalia; quæ via vera est, sed*" (too often, we fear) "*intentata.*" With a great din of shouting sounding in his ears, Dr. Odling has wisely preferred to reserve his own voice until he is fairly and fully clear of the wood, and we shall gladly trust ourselves to his guidance.

MISCELLANEOUS.

Obituary.—We regret to have to record the death of Dr. Frederick Penny, the Professor of Chemistry in the Andersonian Institution, to which chair he was elected in July, 1839. His published papers and researches, as well as his great success as a teacher of chemistry in Glasgow, testify to his ability as a chemist and physicist; and his loss will be felt by a numerous circle of students and friends.

Operatic Fireworks.—The manner in which scientific discoveries are applied to utilitarian or, at least, to money-making purposes in this material age is well illustrated in a stage effect obtained in the performance of "Faust" at the Grand Opera in Paris. The scene represents *Mephistopheles* in the act of tapping a great wine-vat, whereupon the stream flows like liquid fire, and, falling into the wine-tub, bursts into flame. Usually, the wine stream has been represented by a "squib," but, in the present instance, by very different means. A vessel for containing water was furnished at one side with a horizontal ajutage, and at the other, immediately opposite the ajutage, with an opening closed by a glass plate. The stream issuing from the ajutage, describing a parabola in its course to the tub below, a beam of electric light, directed through the glazed opening and the contents of the vessel, follows the course of the jet from point to point, so that the entire jet becomes luminous and sparkling, the red colour of molten cast-iron being communicated by making the glass through which the light is transmitted to the water of an orange-red tint. The fireworks ignited in the tub to produce the flame previously mentioned are believed to have been set off by pellets of potassium, fired by contact with the water in the manner very generally known. A foreign contemporary suggests that a similar application might be made of the recent discovery by Professor Nickels—that, if commercial chloride of copper be mingled with sulphide of carbon holding phosphorus in solution, the mixture will only smoke, whereas the addition of a little ammonia (either gaseous or aqua ammonia) will insure its instantaneous bursting into flame. It was by means like this that, in the old times, sorcerers wrought their wonders to the astonishment alike of kings and people; but, in these days, the stage-carpenter enables, for a few dimes, miracles to be witnessed for amusement that, a few generations ago, would have filled multitudes with awe.—*American Artisan.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, November 15, 1869.

This number contains the following original memoirs and papers relating to chemistry and allied sciences.

Researches on the Luminous Effects Due to the Action of Light upon Different Bodies—Refrangibility of the Active Rays.—M. Becquerel.—This is the fifth instalment of a lengthy memoir on this subject. In order to study very completely the mode according to which the exciting action (*action excitatrice*) of the solar spectrum is distributed when made to illuminate bodies not possessed of any great phosphorescence, the author applies a wide-mouthed phosphoroscope. The substance to be investigated is reduced to a fine powder, and fixed, by means of a little gum-water, to a plate of mica. The author's experiments led to the following conclusions:—The most refrangible rays, and principally those beyond the violet, are the most active; the different parts of the solar spectrum differ in their activity; the least refrangible rays from the blue, and past the ultra-red, act especially as extinguishers of phosphorescence.

Petroleum in the Netherlands' East Indies.—Dr. von Baumhauer.—The author gives a complete description of a large number of sources of petroleum discovered in different islands of the Indian Archipelago, which are dependencies of the Netherlands. The author states that, from observations and experiments made, there exists, at 250 metres' depth, an almost inexhaustible reservoir of this fluid.

Facts relating to Interverted Sugar.—M. Maumené.—The so-called interverted sugar is prepared by the author in the following manner:—Perfectly colourless sugar-candy is pulverised and thoroughly washed, first, with pure ether, and then with perfectly pure absolute alcohol; the powder is next dissolved in about five times its weight of very pure distilled water, to which is added 1 c.c. of pure concentrated hydrochloric acid (this quantity of acid is sufficient for the conversion of 1 kilo. of pure sugar). The aqueous solution is heated on a water-bath for a few hours, until colouration just begins to be perceptible. The HCl is removed, by the quantity of oxide of silver required for that purpose, with only five milligrms. excess; the chloride of silver is

separated by filtration; the filtered liquid treated with sulphuretted hydrogen, to make perfectly sure of the removal of all metal; the liquid again filtered, and next evaporated upon a water-bath, yielding perfectly pure glucose. The remainder of this paper is a critical review of M. Dubrunfaut's labours, and too lengthy to admit of any useful abstraction.

Lower Lignites of the Plastic Clay of the Paris Basin.—M. Planté.—An interesting paleontological paper.

Chemical Composition and Mode of Deposition of the Layers of the Great Oolite and Forest Marble in the Haute-Marne.—M. Guignet.—After referring, at some length, to the peculiar geological features of this portion of France, the author communicates the analysis of a peculiar kind of soil, which, in 100 parts, consists of—Silica, 50·0; alumina, 15·0; peroxide of iron, 10·0; lime, 2·5; water, 5·0; magnesia, manganese, sulphuric acid, and other non-determined substances, 17·5; the greater portion of this paper is chiefly of local interest.

Permanganic Acid.—M. Delaurier.—After briefly referring to former communications on this subject, the author states—Manganate of lime is produced by heating, with access of air, 1 equiv. of peroxide of manganese, and 1 equiv. of lime. This compound exhibits a brown colour; and when the ignition is continued, the mixture, being stirred to promote the access of air, it is converted into permanganate of lime, exhibiting a blackish colour, and being more fusible than the manganate—

$$2CaO,MnO_3+O=CaO,Mn_2O_7+CaO.$$

This substance is a powder; and when the author tried to set free permanganic acid from it, by means of 2 equivs. of sulphuric acid diluted with some water, the heat thereby disengaged is too great, and the permanganic acid is decomposed into sesquioxide of manganese and oxygen; but when fused permanganate of lime is applied, the action of the sulphuric acid is slow, and the permanganic acid may be obtained by distillation at a temperature of from 60° to 70°.

This number contains several papers relating to meteorology and luminous meteors—among these, a lengthy account, accompanied with an engraving, of a bolide and its explosion, observed by M. J. Silbermann on the 11th inst., at nearly 11 p.m.

Annalen der Chemie und Pharmacie, October, 1869.

This number contains the following original papers and memoirs:—

Researches on the Essential Oil of the Fruits of Heracleum Spondylium.—M. Zincke.—The essential oil was obtained by distilling, with water, the fruits of the *Heracleum spondylium*. 80 lbs. of the fresh fruits yielded 120 grms. of oil; the water which came over with the oil exhibited a very strongly acid reaction to test paper, and was, therefore, also subjected to investigation. The essential oil which was obtained was of a bright green colour, very fluid, and exhibited only a slight smell, which was rather pleasant; its taste was burning and acrid; sp. gr. at 20°, 0·864; slightly acid reaction to test paper; did not yield, when treated with a concentrated solution of bisulphite of soda, any crystalline substance (stearopten); submitted to fractional distillation, there were obtained two portions—one (about 14 grms.) came over at from 190° to 195°, the other portion (of about 40 grms.) came over at 206° and 208°. This last portion exhibited a perfectly clear neutral fluid, insoluble in water, but miscible with alcohol and ether; sp. gr. at 16°, 0·8717; formula, $C_8H_{10}O$. This portion of the oil turned out to be, on further investigation, an octyl-alcohol; formula, $C_8H_{18}O$. The following derivatives of octyl-alcohol were investigated:—Chlorooctyl, $C_8H_{17}Cl$; bromooctyl, $C_8H_{17}Br$; iodooctyl, $C_8H_{17}I$; octylic acid-octyl ether, $C_8H_{17},C_8H_{15}O_2$; benzoic acid-octyl ether, a colourless fluid, exhibiting an aromatic odour, boiling at about 306°, insoluble in water, but readily soluble in alcohol and ether. The investigation of the first portion of the oil (boiling between 190° and 195°) proved it also to contain an octyl-alcohol, but along with it some substances the nature of which could not be ascertained with certainty. The acid-water above alluded to was found to contain acetic and capronic acids.

Synthesis of a Hydrocarbon of Ethyl-Vinyl isomeric with Butylen.—M. Wurtz.—In order to prepare hydrocarbons synthetically, the author causes zinc ethyl to act upon organic bromine or iodine compounds. Zinc ethyl and bromated ethylen are mixed, and heated to 140° in sealed tubes, and next left standing for several weeks. Previous to opening the tubes, these should be placed in freezing mixture, and the gas which is given off when the tubes are opened is made to pass into broming. The bromated compound thus obtained is a perfectly clear liquid, boiling at 166°; sp. gr., 1·876. When this bromated compound is treated with sodium, ethyl-vinyl is set free; this substance is a fluid boiling at −5°.

Researches on the Constitution of Piperine and its Products of Decomposition, Piperinic Acid and Piperidine.—MM. Fittig and Mielch.—This memoir, of which the first instalment is here given, is divided into the following sections:—1. Preparation and properties of piperinic acid.—This acid is prepared by gently boiling, for about twenty-four hours, a mixture of 1 part of piperine, 1 part of caustic potassa, and 5 parts of alcohol, yielding piperinate of potassa. The authors have tried to split up piperine by means of hydrochloric acid; this method, however, proved unavailable, since there were by-products formed which destroyed nearly all the piperinic acid. Piperinic acid, when pure, is a colourless solid substance, fusing between 212° and 213°; when submitted to distillation along with excess of lime, phenol is among the products of the decomposition. 2. Experiments made in order to solve the question whether piperinic acid contains HO or CH_2O, C_2H_2O, &c.—From the lengthy series of experiments instituted by the authors, the conclusion is that piperinic acid is a monobasic, as well as a monatomic acid. 3. Products of the oxidation of piperinic acid.—(*a*) Behaviour of piperinic acid towards chromic acid. (*b*) Behaviour of piperinic acid with permanganic acid in neutral solution. Piperonal is one of the chief products of the oxidation of piperinic acid; formula of piperonal, $C_8H_6O_3$. Piperonylic acid, $C_8H_8O_4$, stands in the same relation to piperonal as benzoic acid to oil of bitter almonds. (*c*) Action of nascent hydrogen gas upon piperonal and piperonylic acid. (*d*) Piperinic acid and nitric acid. 4. Action of bromine upon piperinic acid. 5. Hydro-piperinic with oxidising substances and bromine.

Researches on the Creosote obtained from Rhenish Beech-Wood Tar.—M. Marasse.—From the introduction to this paper, we learn that there exists some difference between the creosote obtained from beech-wood grown along the Rhine and that grown in a portion of Southern Germany. Both kinds of creosote contain guaiacol, $C_7H_8O_2$, and cresol, $C_8H_{10}O_2$, and, moreover, in addition thereto some other substances not containing oxygen. The author's researches on the Rhenish beech-wood tar prove that there are contained in that liquid—guaiacol, cresol, phenyl-alcohol, and substances homologous therewith. The lengthy essay is divided into the following sections:—(*a*) Researches of the fluids boiling below 199° (the raw material operated on was a rectified creosote of commerce of excellent quality, manufactured by MM. Dietze and Co., operative chemists, at Mainze); (*b*) action of powdered zinc upon creosote boiling between 200° and 203°; (*c*) action of fusing caustic potassa upon creosote of the same boiling point; (*d*) action of hydrochloric and hydriodic acids upon that same creosote; (*e*) preparation of the methylic ether of cresylic alcohol and of the neutral methylic ether of pyrocatechin; (*f*) action of hydriodic acid upon creosote boiling at between 217° and 220°; (*g*) action of hydrochloric acid and chlorate of potassa upon guaiacol; (*h*) action of the last-named chemicals upon creosote boiling at between 200° and 203°. The author of this paper adds a foot-note, of the following purport:—It is generally taken for granted that the use of chromate of lead, in the elementary organic analysis, is preferable to that of oxide of copper whenever the complete combustion of difficultly-combustible substances has to be provided for; but the author found that in the case of cresylic alcohol (even when a current of oxygen is made to pass through the combustion-tube towards the end of the operation), its complete combustion is impossible. As the cause for this phenomenon, the author assigns the fact that a portion of the chromate of lead is entirely reduced to the metallic state, and that this lead retains carbon, preventing its combustion. It is, perhaps, not out of place here to observe that this same observation was made about thirty years ago by the late Berzelius, who therefore advised the admixture of pure and carefully-fused bichromate of potassa in small quantity to the chromate of lead.

Products of the Oxidation of Toluol-Sulpho Acid by Fusing Caustic Potassa.—M. Barth.—The author obtained, by this reaction, paraoxybenzoic acid, salicylic acid, cresol, and other substances. Paraoxybenzoic acid fuses at 210°, and crystallises in prismatic-shaped large white-coloured crystals; formula, $C_7H_6O_3+H_2O$.

Constitution of Phloretinic Acid and Tyrosine.—M. Barth.—When phloretinic acid is submitted to fusion along with excess of caustic potassa, the author obtained a substance, $C_7H_6O_2+H_2O$. On further investigation of this subject, the author came to the conclusion that there exist two acids—

$$C_6H_4\begin{cases}OH\\C_2H_3O_2\end{cases}$$

each of which yields, on becoming oxidised, paraoxybenzoic acid. Tyrosin, when pure, also yields, on fusion with caustic potassa, the same acid. The theoretical reasonings of the author, concerning the constitution of tyrosine—

$$C_6H_3\begin{cases}OH\\NH.C_3H_5\\COOH\end{cases}$$

are too abstruse to be suitable for abstraction.

Decomposition of Acetate of Silver under the Influence of Iodine and a High Temperature.—M. Birnbaum.—After reviewing the labours of MM. Weltzien, St. Claire-Deville, Bourgoin, and others who have experimented on this subject, the author states that he obtained, by causing iodine to act upon acetate of silver, chiefly two substances—viz., a fluid, and a mixture of gas, chiefly carbonic acid; the fluid is acetic acid, while among the gases elayl and acetylen could be readily detected. When the rather violent reaction is moderated, the author found that the following products are formed:—Iodide of silver, acetate of methyl, acetic acid, carbonic acid, acetylen, hydrogen, and sometimes silver and carbon. The quantities of these substances vary considerably, and it is the author's opinion that this should indicate that several reactions are going on at the same time. The reaction may be represented by the following formula:—

$$2CH_3COOAg+I_2=CH_3COOH+CH_2+CO_2+2AgI;$$

$$2CH_2=C_2H_2+H_2.$$

Acetate of silver, when in aqueous solution, behaves with an aqueous solution of iodine in a different manner, and the reaction is expressed by the following formula:—

$$6C_2H_3AgO+6I+3H_2O=6C_2H_4O_2+5AgI+AgIO_3.$$

On Sulphate of Amarine.—M. Groth.—The author first refers to M. Laurent's researches on this subject, and then says that he could only experiment with a very small quantity of the above-named substance, which had been forwarded to him more for crystallographical than for chemical research. Sulphate of amarine is tolerably soluble in water; its water of crystallisation is driven off at about 210°; composition, $2(C_{21}H_{12}N_2)2SO_4+7aq$.

Formation of Phenols when Chloride of Zinc Acts upon Camphor.—M. Rommier.—According to the late M. Gerhardt

camphor is converted into cymen and water by distillation with chloride of zinc, according to the formula $C_{20}H_{16}O_2=C_{20}H_{14}+2HO$. Very many experimenters—among them, MM. Lippmann, Longuinine, Fittig, &c.—have found it either impossible, or, at least, very difficult, to obtain this result. The author states that he operated with 2 kilos. of camphor, and obtained about 700 grms. of a volatile oil boiling between 140° and 240°; this oil proved to be a mixture of various substances, among which were cresyl-alcohol, several hydrocarbons, and other products of decomposition, due rather to the high temperature than to the simple elimination of water by the chloride of zinc and high temperature together.

Conversion of the Butyric Acid of Fermentation into Normal Primary Butyl-Alcohol, and into Ordinary Butyl-Alcohol as obtained by Fermentation.—M. Linnemann.—This is only a brief preliminary notice written *pour prendre date*.

Cosmos, November 13, 1869.

This periodical contains the following original papers and communications:—

Estimation of Nickeliferous Iron in Meteoric Stones.—M. Meunier.—There are three methods chiefly in use for this purpose—viz., separation of the metal by means of a magnet; solution of the metal in a solvent, which leaves the remainder of the material composing the stone untouched; and the measuring of the hydrogen set free by the solution of the metal in a confined space. The author has added to these methods of estimation another, which he describes as follows:—When the meteorite to be investigated is very finely pulverised in an agate mortar, there is added to it an excess of a solution of chloride of gold in water, the iron (present in the form of minute particles) is rapidly dissolved, and there is formed a precipitate of metallic gold equivalent to the quantity of iron present. The solution of the iron takes place rapidly, so that after a few minutes the operation is complete. The contents of the small flask, wherein the operation took place, are placed on a filter and thoroughly washed with water until the excess of chloride of gold is washed out. When this point has been arrived at, the remainder upon the filter is washed with moderately dilute hydrochloric acid, in order to remove the last traces of any chloride of gold adhering to the stony matter of the meteorite; this having been done, the residue on the filter is removed to a small flask, and therein treated with *aqua regia* (nitro-hydrochloric acid), and the quantity of gold estimated in the liquid by well-known methods. By multiplying the weight of the gold thus obtained by the rapport of the equivalents of gold and iron, that is to say, by—

$$\frac{28}{98{\cdot}18} = 0{\cdot}286$$

the weight of nickeliferous iron is obtained. The author states that he has tested this process, and compared it with the others above alluded to, and found it to yield very correct results.

Quino-Picric Acid.—MM. Duguet and Perret.—A golden-yellow coloured substance, exhibiting a very bitter taste, difficultly soluble in water, but readily in alcohol; also soluble in ammonia and the aqueous solutions of alkalies, without decomposition; not perceptibly acted upon by daylight and air when placed in closed bottles. When projected on burning coals, this substance burns off like lycopodium, but does not detonate; on being ignited on platinum foil, no residue is left if the substance is pure. The composition of this material, which is applied as a febrifuge, is stated to be, in round numbers—Alkaloids, 58; picric acid, 42. It is manufactured by acting with picric acid upon those alkaloids of the *cinchonæ* species (viz., quinidine, quinicine, cinchonine, cinchonicine, &c.), which are not used as medicine by themselves, and, in a sense, valueless.

Annalen der Physik und Chemie, von Poggendorff, No. 10, 1869.

This number contains the following original papers:—

Thermo-Chemical Researches.—M. Thomsen.—This is the second instalment of a lengthy memoir. This portion treats of the hydracids of chlorine, bromine, iodine, fluorine, and cyanogen.

Combinations of Alcohol and Water.—M. Mendelejeff.—The second and concluding part of a very lengthy essay on a subject which is of very great importance, both in a scientific and practical point of view, in consequence of the excise duty on spirits. In this portion of the paper, a chapter is devoted to absolute alcohol. After referring to the discrepancies of the specific gravity of that fluid, as determined by different experimenters, the writer proceeds to state that he has reviewed this subject entirely, taking care to obtain alcohol chemically pure (a far more difficult problem than is generally believed); next, also, avoiding, or, at least, taking into account, the very rapid absorption of water and air (absolute alcohol absorbs air readily—100 volumes of that fluid absorb, at 15°, and 760 m.m. barometer, 10·1 volumes of nitrogen and 6·3 volumes of oxygen). The author found the specific gravity of pure absolute alcohol to be 0·79845 at $\frac{20°}{4°}$ C. In order to dehydrate the alcohol, the following substances were tried:—Potassa, chloride of calcium, dried sulphate of copper, anhydrous oxide of barium, sodium-amalgam, and quicklime; the latter is the substance best suited for that purpose. The paper further contains chapters on the contraction of mixtures of alcohol and water, and on the changes of specific gravity of mixtures of alcohol and water.

New Sulpho-Salts.—M. Schneider.—Sulphide of silver and sulphide of iron, $Ag_2Fe_2S_3$; in 100 parts—Silver, 47·38; iron, 24·56; sulphur, 28·06. This compound exhibits the following properties:—Iron-grey coloured shiny crystalline needles, unaltered in dry air, but becoming rapidly rust-coloured when exposed to moist air; not acted upon by very dilute hydrochloric acid, but becoming rapidly decomposed by the action of stronger acid, sulphuretted hydrogen becoming evolved. Heated in a dry glass tube, this compound fuses, and vapours of sulphur are given off, leaving a residue consisting of protosulphuret of iron and metallic silver. Sulphide of sodium with sulphide of iron, containing water, $Na_2Fe_2S_4+4H_2O$; in 100 parts—Sodium, 12·43; iron, 31·07; sulphur, 35·44; water, 19·58. Sulphide of sodium with sulphide of bismuth, $Na_2Bi_2S_4$; in 100 parts—Sodium, 7·79; bismuth, 70·51; sulphur, 21·70. Cuprosulphide of sulphide of potassium with sulphide of copper, $K_2Cu_2S_2$; in 100 parts—Potassium, 10·05; copper, 65·27; sulphur, 24·68. Disodium-cuprosulphide with sulphide of copper, $Na_2Cu_2S_2$; in 100 parts—Sodium, 13·84; copper, 57·29; sulphur, 28·87. Potassic-sulphide of iron with sulphide of copper, $K_2FeCu_2S_4$; in 100 parts—Potassium, 17·28; iron, 12·37; copper, 42·08; sulphur, 28·27. Ferro-sodium-sulphide of copper with sulphide of copper, $Na_2FeCu_2S_4$; in 100 parts—Sodium, 10·94; iron, 13·32; copper, 43·50; sulphur, 31·44.

Emission and Absorption of the Heat-Rays Emitted by Bodies at Lower Temperatures.—M. Magnus.—The main points of this paper are:—Different bodies, heated to 150°, emit different kinds of heat; some substances only emit one kind of heat—others, again, various kinds. Pure rock-salt is monothermic; sylvin (chloride of potassium) behaves in a similar manner.

NOTES AND QUERIES.

Bisulphite of Lime.—(Reply to "A. N. Palmer.")—This substance is made by passing a current of sulphurous acid gas into milk of lime until a clear liquid is obtained and the lime dissolved. Care should be taken to wash the sulphurous acid.

Shoddy.—(Reply to "Child.")—Use nitric acid; this will have the effect you desire, of reducing the woolly substance to a pulpy mass converting it into xantho-proteic acid, which is valuable as manure. By applying the acid named, you can somewhat reduce the quantity of sulphuric acid for dissolving phosphates.

Aluminium Sulphide and Phosphide.—I wish to obtain a small quantity of sulphide and phosphide of aluminium, and should feel greatly obliged if you could inform me where it is probable I could obtain them. I have tried most of the London retail houses, but without success, neither have I been successful in making these compounds, though following the methods described in Watts's "Dictionary," vol. i., rather strictly. Perhaps you could likewise inform me where I could find the processes described in greater detail.—D. H.

The Atomicity of Aluminium.—Would some kind reader oblige an intending candidate for examination by communicating the most rational view of the atomicity of aluminium? Miller classes it as a triad, while Williamson states it to be of "even atomicity;" Roscoe called it tetratomic, but has withdrawn that assertion from his last edition. Messrs. Mottershead profess to follow Roscoe in their chemical labels, but give the symbol for alum $Al(NH_4)_2SO_4+12H_2O$; This, I presume, is a misprint (though still remaining uncorrected); but why should the single formula be given, instead of the double one of the books?—DUBITANS.

By-Products Containing Soluble Phosphates.—(Answer to "Arthur Warner").—It is not at all likely you will meet with any such by-product, unless, perchance, in the mother liquor of phosphate of soda manufacture; but phosphoric acid is too valuable a substance to be negligently dealt with. There is a method of extracting gelatine and glue from bones, whereby the latter are first treated with a moderately strong hydrochloric acid which dissolves the mineral matter of the bone, and, consequently, contains all the phosphates thereof in soluble state; but where you could obtain such liquor we are unable to say; perhaps glue and size makers would be able to inform you.

MEETINGS FOR THE WEEK.

MONDAY, 29th.—Medical, 8.
—— London Institution, 4.
TUESDAY, 30th.—Royal, 4. Anniversary.
WEDNESDAY, Dec. 1st.—Society of Arts, 8.
—— Pharmaceutical, 8.
THURSDAY, 2nd.—London Institution, 7.30.
—— Chemical, 8.

TO CORRESPONDENTS.

Tallow Melter.—Please forward your address, as a letter is waiting for you at our office.

E. H. & Co.—You can learn particulars about the automatic steam-boiler feeding apparatus with constant level by writing to M. E. Leroux, 11, Rue des Beaux-Arts à Paris.

An Old and Regular Subscriber.—Address to M. Théodore Péters, fabricant de couleurs d'aniline et d'orseille, Chemnitz, Saxony.

F. Sutton.—Received, with thanks.

Enquirer.—(1) L. Oertling, 27, Moorgate Street, E.C. (2) None but good ventilation.

M.—See Eggertz's process, given in the CHEMICAL NEWS a short time back.

R. R. Tatlock.—Received, with thanks.

THE CHEMICAL NEWS.

VOL. XX. No. 523.

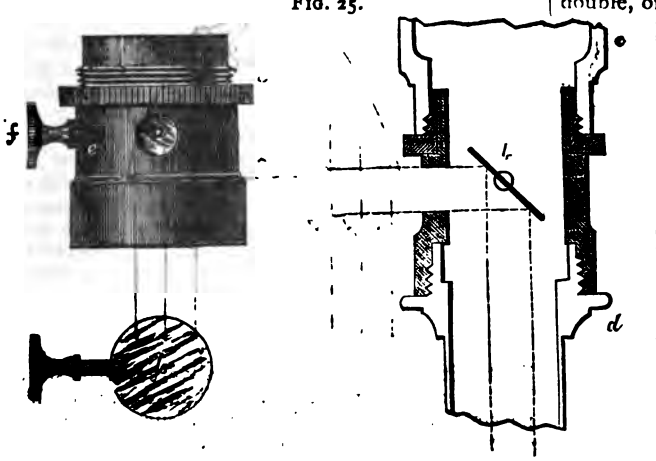
ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 256.)

A MEANS of illumination adapted for use with objectives of high power, in which the space above the object is too small to admit of light being thrown upon it by any of the apparatus just described, has been contrived by Professor H. L. Smith, of Kenyon College, Ohio. He uses the object-glass itself as a condenser. A pencil of light is admitted through an aperture in the side of an adapter screwed on to the body of the microscope, which contains a small silvered mirror with suitable adjustments for reflecting the pencil downwards through the object-glass which is attached below the adapter. This apparatus was sent to Mr. E. G. Lobb, of the Royal Microscopical Society, and exhibited at the meeting in January, 1866. The instrument was placed in the hands of Messrs. R. and J. Beck and Messrs. Powell and Lealand, who each produced an improved modification. For the silvered mirror of Professor Smith they both substituted an unsilvered glass surface; that of Messrs. Powell and Lealand was a piece of parallel surfaced glass, fixed at an angle of 45°; Messrs. Beck used a disc of thin cover glass (Fig. 25, *b*), and allowed the angle to be altered at pleasure by means of a milled head, *f*, passing through the aperture, *e*. The light of a lamp is directed through the hole, *a*, in the adapter, and forms an image of the flame on the object when the object-glass is in focus. The lamp should be placed at a distance of about eight inches from the instrument; sometimes a condensing lens may be placed between the lamp and microscope with advantage. The manipulation with the instruments of both makers is precisely similar. The objects to be viewed with this illuminator should be uncovered, otherwise the cover reflects nearly the whole of the light, and scarcely any falls upon the object; some light is also lost by reflection on its passage upwards through the oblique unsilvered mirror. The impossibility of obtaining a satisfactory view of a covered object will most probably prevent this instrument from coming into very general use, although it affords valuable information to those who will take the trouble to master the difficulties attending its use.

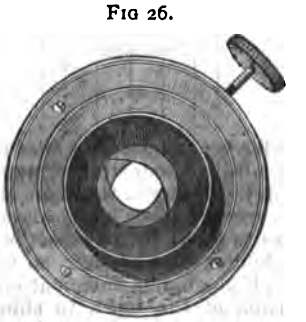
FIG. 25.



The second class of illuminators, those which are placed beneath the stage, are also very numerous. The most familiar is the *mirror*, which forms a part of every microscope. A great variety of illumination may be obtained from the mirror alone, if properly mounted so that it may be turned considerably aside. The mirror of many microscopes is now placed on a double-jointed arm, which permits very oblique illumination to be obtained. In order to understand practically the difference caused by the position of the mirror, the student is recommended to examine a diatom of moderate difficulty, such as *Pleurosigma angulatum*, with a good ⅓ or ¼ objective, which should be accurately adjusted for the thickness of the cover glass, and a deep eye-piece should be used. It will be found, when the light is central, that none of the usual markings will be visible; but when the illuminating pencil falls very obliquely, the *apparent* cross lines (?) will come into view. With the better class of microscopes, the mirror is usually made double, one side concave and the other plane; the plane mirror is used for reflecting daylight when the greatest intensity is not required, and for use with the achromatic condenser and parabolic reflector (Wenham's), and in all other cases when parallel rays are needed. The concave mirror acts in some degree as a condenser, and is to be used with lamp light and when it is required to make daylight more intense. The *diaphragm plate* is used in combination with the mirror to regulate the angle of the pencil; this can, however, be done with much greater nicety by employing the graduating diaphragm of Mr. Collins (Fig. 26) or the very beautiful iris diaphragm of Messrs. Beck (Fig. 27), both of which allow the aperture under the stage to be gradually diminished or enlarged without the interval of darkness which occurs during the shifting of the ordinary wheel of diaphragms.

A very useful illumination, resembling the light of a *white cloud*, may be obtained by placing a piece of white paper over the mirror, and concentrating the light of a lamp upon it by means of the con-

FIG 26.



* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1866.

Hence there is only one fixed term of solubility, namely, that given by the 10-atom salt, and represented by 1120 at 18° C. Whatever modifications are produced in the solutions by means of temperature or supersaturation, the mother liquor always returns, after the lapse of sufficient time, to this normal, fixed density of 1120.

In considering the abnormal solubility of the anhydrous salt, whether obtained by drying or fusing the 10-atom variety, and in comparing the amorphous state of this salt with sugars in the state of supersaturation, are we not led to conclude that the molecular constitution of the anhydrous sulphate has the same constitution as that of the sugars in supersaturated solutions?

The depression in temperature which accompanies solution implies a transfer of heat into molecular mechanical work under the conditions of supersaturation. When this state ceases, the temperature rises, implying an inverse transfer of mechanical work into heat, in consequence of the return of the saline molecule to its primary constitution.

The facts of superfusion and supersaturation are well explained by changes in physical and chemical constitution brought about by fusion or solution, the two molecular conditions being, probably, the crystalline and the amorphous.

Such are M. Dubrunfaut's views, which I have endeavoured to give in a condensed form. M. Margueritte replied, on June 7th, that M. Dubrunfaut's hypotheses are contradicted by experiment. Crystallised sugar may form supersaturated solutions in dilute alcohol, and still preserve intact its optical properties, and, therefore, the identity of its constitution, a fact which proves that the increased transitory solubility of a body is not the effect of a molecular change or of an isomeric modification.

The same number of the *Comptes Rendus* contains also a note by M. Lecoq de Boisbaudran, in reply to M. Dubrunfaut. After some remarks on change of structure by means of fusion, which produces modifications similar to those which result from solution, he admits that Löwel's hypothesis rests on facts observed under conditions when supersaturation no longer exists. While not agreeing with M. Dubrunfaut, he does not insist on his own hypothesis; and, although optical tests fail in the case of sodic sulphate, yet an experiment with chrome alum shows the co-existence of two different modifications in a definite state of solution. Dissolve chrome alum in the cold, and the solution has a blue-violet colour; dissolve the same salt in boiling water, and the solution is dark green. If the two solutions be exposed to the ordinary temperature, the blue solution soon loses a little of its purity, and tends to become greenish, while the green solution tends to become bluish, until at length the two solutions pass into the same green-blue colour, which represents the intermediate state between the initial modifications.

M. Lecoq de Boisbaudran cannot understand M. Dubrunfaut's object in undertaking new experiments on the density of the mother liquors of sodic sulphate, since it has long been known that, by exposure to the air, the 10-atom salt is produced from the various solutions, and that, under like conditions of temperature and saturation, the densities must be equal. If M. Dubrunfaut had operated on the anhydrous salt without exposure to the dust of the air, he would have obtained a stronger mother liquor. When a supersaturated solution resting on an excess of the anhydrous salt is suddenly solidified by contact with a crystal of the 10-atom salt, the mother liquor of the anhydrous salt is much richer than the mother liquor of the 10-atom crystals. He believes that the solubilities of all three varieties of the same salt to be equally normal. The solubility of a body ought to be definite under determined physical conditions (temperature, pressure, &c.); but, if such body is in the presence of one of its more stable modifications, this will destroy the initial modification, and we should certainly fall into error in attributing to the primitive body the observed solubility.

M. Dubrunfaut, abandoning the hypothesis which supposes the 10-atom sodic sulphate to exist as the 7-atom in solution, now supposes the anhydrous salt to be in solution. The objections to the opinion that only the 7-atom salt is in solution apply with even more force to the new proposal to make the anhydrous salt play the same part.

Such is the state of the question at the present time among the French chemists whose views are reported by the Academy. The favourite view of supersaturation, both in French as well as English, American, and, I may add, German text-books, is Löwel's—namely that a solution (say of sodic sulphate) saturated at a high temperature, and left to cool in a close or loosely covered vessel, does not actually become supersaturated, but undergoes a molecular change, in which the 10-atom salt becomes the more soluble 7-atom; so that, instead of having a supersaturated solution of the 10-atom salt, we have only a saturated solution of the 7-atom. When, however, under the influence of some mysterious catalytic action, crystallisation is about to set in, the solution suddenly recovers the molecular constitution of the 10-atom salt, as well as its solubility, and the 10-atom salt is thrown down.

All this is very ingenious. The most remarkable circumstance connected with the Löwel hypothesis is that Löwel was himself the first chemist who called it in question. The facts are these:—Löwel's first memoir appeared in 1850; his fifth in 1855; in all of which he maintains the molecular theory above stated in the case of sodic sulphate, and a similar theory with respect to two other salts—viz., the sodic carbonate and the magnesia sulphate. But, in 1857, he published a sixth memoir, in which he strongly inclines to the opinion that, within the limits of a considerable range of temperature, sodic sulphate in solution is in the anhydrous condition. His views will be given in another article.

Highgate, N., November 22nd, 1869.

ON THE

COMBINATIONS OF PHOSPHATE OF LIME AND SULPHUROUS ACID.*

By Dr. B. W. GERLAND, Macclesfield.

PHOSPHATE of lime, in whatever state it may be, readily dissolves in an aqueous solution of sulphurous acid. The solution can be obtained of great strength; thus, from freshly-precipitated tribasic phosphate of lime, a liquor was prepared of 1·3 specific gravity; and, from bone-ash, one of 1·1708 specific gravity. The former contained, in 1000 c.c.—

	grms.
Sulphurous acid	218·38
Sulphuric acid	0·70
Lime	101·79
Phosphoric acid	82·89
	403·76

These figures agree tolerably with the formula—

$$3CaO,PO_5+6SO_2,$$

as the comparison with the calculated table shows—

$3CaO$	84	98·20
PO_5	71·4	82·89
$6SO_2$	192	224·45
		405·54

* Read before the Manchester Literary and Philosophical Society, Nov. 16th, 1869.

The solution of bone-ash, in sulphurous acid of 1·1708 specific gravity, was found to contain, in 1000 c.c.—

	grms.
Sulphurous acid	141·82
Sulphuric acid	trace
Phosphoric acid	47·42
Magnesia	2·79
Lime	59·69
	251·72

The formula $3CaO,PO_5,6SO_2$ requires, for 47·42 PO_5—

	grms.	
Lime	55·78	
Phosphoric acid	47·42	
Sulphurous acid	127·50	
		230·70
The excess of lime in the analysis is		3·91
and magnesia		2·79
These two would require sulphurous acid		8·73
Excess of sulphurous acid		5·58
		251·71

The bone-ash which was left undissolved by the sulphurous acid had lost all its magnesia, a circumstance which accounts for the large amount of magnesia in the liquor.

The proportion of $3CaO,PO_5$ and SO_2 varies according to the strength of the liquor; if the latter is, for instance, 1·060 specific gravity, 5eq SO_2 dissolve $3CaO,PO_5$; and, in still weaker solutions, we find only 4eq SO_2 for $3CaO,PO_5$.

These solutions possess very interesting reactions, some of which are the following.

A neutral solution of ferric chloride precipitates straw-coloured phosphate of iron, and, if added in proper quantity, the liquor is free from both iron and phosphoric acid. The precipitate, after washing and drying over sulphuric acid, is free from lime and sulphurous acid. Its analysis agrees well with the formula Fe_2O_3,PO_5+5HO.

Acetate of copper colours the sulphurous acid solution, when added in small quantity, intensely green; a further addition produces a thick yellow precipitate, which rapidly changes in contact with air, and thereby becomes green. Acetate of lead also produces a thick precipitate of white colour. These precipitates contain, besides the metallic oxide, lime, phosphoric and sulphurous acids. Chloride of barium precipitates the solution directly, and chloride of magnesium after some standing.

The solution of phosphate of lime in sulphurous acid possesses the taste and smell of the acid, but to a much smaller extent than an aqueous solution of the acid containing the same amount of sulphurous acid.

Under the influence of boiling heat, the phosphate solution is decomposed slowly, sulphurous acid escapes, and a heavy white crystalline precipitate is formed. Under the microscope, it appears as composed of crystals of the hexagonal system, like those of rock-crystal. Washed and dried over sulphuric acid, it contained—

Sulphurous acid	15·61
Sulphuric acid	0·23
Lime	39·89
Phosphoric acid	34·48
Water	9·08
	99·29

These numbers agree with the formula—

$$3CaO,PO_5,SO_2,2HO,$$

the calculated numbers of which are—

SO_2	32		15·58
$3CaO$	84		40·89
PO_5	71·4		34·76
$2HO$	18		8·77
	205·4		100·00

This sulphited phosphate of lime has no smell or taste, and is distinguished from all sulphites by its stability. Heated in an air-bath for three hours to 130° C., it lost 0·64 per cent of water; but the amount of sulphurous acid remained unchanged, neither had a humid atmosphere the slightest effect upon it. The water is held in intimate combination, and is only expelled at a higher temperature when it is accompanied by fumes of sulphur, sulphuric and sulphurous acids. The residue contains, besides lime and phosphoric acid, sulphate and sulphide of calcium.

Cold water has no effect upon the sulphited phosphate of lime. After long-continued boiling, the air being excluded, a partial decomposition takes place, which is shown by the following analysis.

1000 c.c. of the water contained—

	grm.
SO_2	0·2680
SO_3	0·0470
PO_5	0·1181
CaO	0·2045

And an undetermined quantity of the undissolved residue contained—

SO_2	0·03464
PO_5	0·12393
CaO	0·13916

The constituents are, therefore, in the following proportions:—

In the solution—

1 eq. PO_5 : 4·35 eq. CaO : 5·07 eq. SO_2 : 0·71 eq. SO_3;

And in the residue—

1 eq. PO_5 : 2·85 eq. CaO : 0·623 eq. SO_4.

The sulphite, which withstands the action of the atmosphere indefinitely, is rapidly oxidised when incorporated with soil. A quantity was buried in a heavy clay soil (which, as was ascertained previously, contained no lime and phosphoric acid soluble in dilute hydrochloric acid), and was exhumed after two months, when it was found to be free from sulphurous acid. The sample was selected for analysis with the least possible quantity of soil. It contained—

	per cent.
SO_3	18·59
PO_5	24·58
CaO	33·66

The oxidising process which has taken place in this instance may be expressed by the formula—

$$3CaO,PO_5,SO_2,2HO+O=2CaO,HO,PO_5+CaO,SO_4+HO.$$

The original substance contained 34·5 per cent PO_5 and 15·8 per cent sulphurous acid, equal to 19·75 per cent SO_3. The sample for the last analysis ought, therefore, to contain, for 24·58 per cent PO_5, 14 per cent SO_3; but, according to the analysis, it contains 18·59 per cent—that is, 4½ per cent more. This excess of sulphuric acid proves that it is dissolved at a slower rate than the phosphoric acid. Calculating the amount of lime which the acids of the analysis require, we find, for—

18·59 SO_3 as CaO,SO_3		13·01 per cent CaO,
And for—		
24·58 per cent PO_5 as $2CaO,PO_5$	19·28	„ „
Total	32·29	„

This number is less than the quantity of CaO found by 1·37 per cent, which excess is to be accounted for by the tendencies of the dibasic phosphate to undergo a partial decomposition under the action of water, in consequence of which a compound of higher basicity is left undissolved.

It is, therefore, evident that the new compound will, in the soil, act as a soluble phosphate of lime; it has, in fact, for several seasons been used as a manure, and has given great satisfaction.

Strong mineral acids dissolve the sulphited phosphate of lime under effervescence of sulphurous acid. Acetic acid has no effect in the cold, and dissolves it only after long-continued boiling, but much easier when the air has access. Oxalic acid decomposes it a little quicker. Chlorine gas is readily absorbed by the new phosphate. After the action is completed, it contains no more sulphurous acid, but only traces of sulphuric acid. Of the phosphoric acid, only a small portion has become soluble (about 1-12th), This decomposition still occupies my attention.

A weak solution of iodine, such as Mohr's standard solution, acts readily upon the sulphited phosphate of lime, as represented by the formula—

$$3CaO,PO_5,SO_2,2HO+I=CaO,2HO,PO_5+CaO,SO_3+CaI.$$

The colour of the iodine disappears as long as there is substance left undissolved. This is a convenient method for estimating the sulphurous acid of the compound; but, as the last portions are only slowly acted upon by the iodine, it is advisable, in order to save time, to add a drop of hydrochloric acid, when the iodine begins to disappear slowly: it does not interfere with the accuracy of the experiment.

The sulphited phosphate of lime, exposed to an atmosphere containing ammonia, rapidly absorbs the latter, but, at the same time, an equivalent quantity of sulphurous acid seems to be oxidised. A sample of the substance was placed under a glass shade with pieces of carbonate of ammonia and water for four weeks, and subsequently over sulphuric acid for two days, and yielded, by analysis, the following results:—

	per cent.
Lime	39·08
Sulphurous acid	2·50
Ammonia	5·60

The new sulphite possesses remarkable antiseptic and disinfecting powers, and, on this account, will command a general interest. The efficacy of sulphurous acid as a disinfectant is well known, and it would be more appreciated if it could be conveniently applied. The aqueous solution is expensive by transport; it is very changeable, and, in many cases, it is unavailable, on account of its pungent smell, whilst, for medical purposes, it can only be used in exceptional cases, in consequence of its irritating action. The sulphites are still more changeable. Exposed to the air, they are acted upon by carbonic acid and by oxygen; and, when mixed with decaying organic matter for disinfecting purposes, they very often increase the mischief, and sometimes cause an abundant escape of sulphuretted hydrogen. The compound of phosphate of lime with sulphurous acid has none of these disadvantages. Acids, as well as ammonia, are neutralised by it. From a sanitary point of view, ammonia is particularly objectionable: being a product of putridity, it helps to accelerate it, and also serves as a vehicle for disseminating other products which, without it, would not be volatile, or only so to a less degree.

The sulphited phosphate, when applied to putrid matter, will probably do its first service by neutralising the ammonia present (including compound ammonias), and also prevent its further formation, as the test-paper will show. The smell will soon cease, or, at least, be greatly diminished and altered, and the mass will be safe for a long time, so that it may be removed or dried without danger or inconvenience. I must here remark that large quantities of putrid matter in open spaces are more completely and speedily disinfected by small portions of the phosphate than samples in glass bottles. The compound recommends itself as a disinfectant by its physical properties. It is a clean white powder, which stains and soils nothing, dusts off garments or carpets, leaving no mark; it is free from smell and taste, and harmless to animal life.

It proves itself invaluable in stables and shippons. The air of these localities is generally highly charged with ammonia, yet the tenants are expected to live and thrive. A regular application of a small quantity of the phosphate will prevent the loss of ammonia, it will sweeten the air, and enrich the manure with phosphoric acid, thus being of threefold advantage. The loss of ammonia from the dung is not inconsiderable; it is also the most valuable constituent of it, being worth more than 9d. per lb. to the farmer.

The solution of phosphate of lime in sulphurous acid also possesses disinfecting powers, and acts, in many cases, even with greater energy than the powder. It might be used with advantage as being applicable to places which could not be reached by the other.

The neutrality, regularity of composition, utter harmlessness, and freedom from smell and taste, recommend the sulphited phosphate of lime for trial in therapeutics. It would be of interest to investigate it in relation to putrid puerperal fevers, pyæmia, &c.

It appeared to me not unlikely that a compound of phosphate of lime with 2 eq. sulphurous acid might exist. Numerous experiments, made with a view of preparing the same, have entirely failed; but some of the results are interesting as showing unexpected reactions of these compounds.

The sulphite of phosphate of lime is not acted upon by the solution of phosphate of lime in sulphurous acid. Sulphurous acid gas is only absorbed in very small proportion by either dry or wet bone-ash. This phosphate of lime is not even converted into the sulphurous acid compound by digestion with the sulphurous acid solution. If sulphurous gas is passed through water holding as excess of phosphate of lime in suspension, the latter remains unchanged.

Under the receiver of an air-pump, the sulphurous acid solution forms good sized crystals, probably belonging to the hexagonal system. Analyses of crystals of different preparations gave varying results, which, however, agreed tolerably with the formula—

$$x(3CaO,PO_5,SO_2,2HO)+y(CaO,SO_2,2HO)+z(CaO,SO_3+5HO).$$

The more crystals separate from the solution, the more the phosphoric acid accumulates in the latter. In one instance, lime, phosphoric acid, and sulphurous acid were almost in proportion of their equivalents.

Alcohol precipitates the solution of phosphate of lime in sulphurous acid. The analysis of the precipitate gave 24·8 per cent of water, and no more sulphurous acid, in proportion to lime, than the above-described powder.

The solution is also precipitated by a current of an indifferent gas, like hydrogen. The analysis of the precipitate gave figures from which no simple formula can be calculated. The amount of phosphoric acid, in proportion to the lime, is greater than that corresponding to tribasic phosphate; and the amount of sulphurous acid is much less than that of the precipitate obtained by boiling. In acordance with the foregoing, the solution, after treatment with hydrogen gas, was found to contain less phosphoric acid, in proportion to the lime, than before.

Under reduced pressure, the phosphate solution boils easier, and the separation of the precipitate takes place more readily. This precipitate contains less sulphurous acid and more water than corresponds to the formula $3CaO,PO_5,SO_2,2HO$.

I experienced so much difficulty in preparing pure tribasic phosphate of lime, that I was obliged to use, for most of my experiments, the phosphate offered by nature in bones and bone-ash.

The compounds of phosphate of lime with sulphurous acid undoubtedly possess great scientific interest. This consideration, as well as the importance they are likely to attain for agricultural and sanitary purposes, as they have now become articles of commerce, has induced me to lay before you the results obtained so far in my investigation, with the prosecution of which I am still occupied.

THE COMMITTEE OF THE BRITISH ASSOCIATION ON THE TREATMENT AND UTILISATION OF SEWAGE.

The following letter has been issued by the above committee to the municipal and sewer authorities throughout the country:—

I have the honour to inform you that, last year, at the meeting of the British Association, at Norwich, a committee was appointed to report on the treatment and utilisation of sewage. In the first instance, a grant of £10 was placed at the disposal of the committee, with which to defray the cost of printing and postage incidental to the collection of preliminary statistical information. Through the kindness of Her Majesty's Government, the committee was enabled to obtain reports respecting the methods of dealing with town refuse practised in most civilised countries; and that information has now been collected in a more complete form than hitherto existed in any country.

This preliminary work being completed, the committee was re-appointed at the meeting of the British Association this year, at Exeter; and the inquiry was considered to present such important features of social and scientific interest, that the sum of £50 was voted towards enabling the committee to enter more fully and practically upon the investigation of this subject. The British Association, being a purely scientific body, has not at its disposal funds which would be adequate or applicable for the full prosecution of this very large and pressingly-important inquiry. The committee, nevertheless, desires to take advantage of the opportunity created by the British Association to investigate the entire subject in all its bearings—whether chemical, physiological, or engineering, sanitary, municipal, or agricultural—and in a manner worthy of the body they represent.

It is unnecessary to point out the enormous importance, especially at the present time, of a full and complete investigation of this question by the light of the knowledge and experience now gained in the several departments above alluded to. But, properly to carry out such an inquiry with a practical end, numerous observations, gaugings, and experiments, aided by simultaneous analyses, are essential; and these cannot be accomplished (especially the analyses) without the continued aid of efficient and, therefore, highly-paid assistants. Moreover, from time to time, it may be necessary for the committee to purchase expensive apparatus, and to subject various inventions and processes to a thorough and complete test; for it is the desire of the committee, not only to ascertain, as far as possible, the causes of the sanitary inefficiency of existing works, but also to inquire into every suggestion which affords promise of practical utility, in order that this investigation may be searching, the report practical, and any recommendations that may be made authoritative.

It is the wish of the several members of the committee to devote, to the utmost of their ability, their personal attention to the work thus sketched out; but the expenses absolutely necessary to enable them to conduct so extended an inquiry cannot but be very heavy, and, unless they are able to secure an adequate fund, they must abandon the attempt to investigate the subject in this broad and comprehensive manner. However, since there is no subject of greater practical and social importance to the public generally, and thus to the various municipal authorities and other governing bodies throughout the country, it is believed that many will share the opinion expressed at the recent meeting of the British Association, at Exeter—that the existence of this committee affords a specially favourable opportunity for such a wide inquiry; and, for that reason, its members confidently appeal to those authorities who are officially interested in the subject to supply the funds necessary for the investigation.

I am, therefore, desired to request that you will kindly submit this letter to the body you represent; and I venture to hope you will give the committee the benefit of your good offices in procuring a subscription proportionate to the population of your town or district. . . .

I am, &c.,

George F. Barnes,
Honorary Secretary, *pro tem.*

22, Whitehall Place, London, S.W.,
November 18th, 1869.

CHLORINE AND METALLIC SODIUM.

By J. ALFRED WANKLYN, F.C.S.

When chlorine gas is passed over metallic sodium—even when the metal is fused, and, whilst in a state of fusion, shaken in contact with the gas, so as to expose fresh metallic surface—there is no action. A glass vessel containing a piece of sodium was weighed; and, after the transmission of chlorine under the circumstances above named, it was re-weighed.

	grms.
Weight before the action of chlorine ..	7·847
Weight after the action of chlorine	7·863
Gain	0·016

The quantity of metallic sodium taken for the experiment was 0·770 grm.

SPECTROSCOPIC NOTES.*

By Professor C. A. YOUNG, of Dartmouth College.

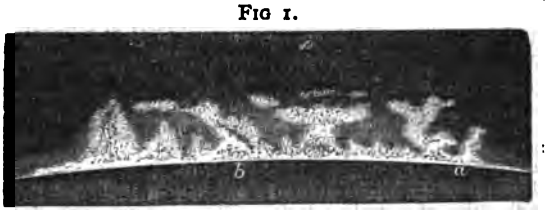
September 4th, 1869.—Prominences were noted on the sun's limb at 3 p.m. to-day in the following positions, angles reckoned from North point to the East:—

1. +70° to +100°, very straggling, not very bright.
2. −10°, large and diffuse.
3. −90°, small, but pretty bright.

September 13th, 1869.—The following protuberances were noted this p.m.

1. Between +80° and +1100, a long straggling range of protuberances, whose form was as in Fig. 1. I dare not profess any very extreme accuracy in the drawings, not being a practiced draughtsman, but the sketch gives a very fair idea of the number, form, and arrangement of the immense cloudy mass, whose height was about 50″

Fig 1.



and its length 330″ (22,500 miles by 1,350,000). The points *a* and *b* were very bright.

2. +135° small, but very bright at the base, of this form (Fig. 2.)

3. −85° of this form (Fig. 3.).

The dark spot, marked *c*, was very curious, reminding one strongly of the so-called fish-mouth in the nebula of Orion. I saw no change in it for 20 minutes. On the

* From the October number of the *Journal of the Franklin Institute*. Kindly communicated, with the cuts, by Professor Morton.

other hand, the first series mentioned were changing rapidly, so that at five o'clock the sketch which was drawn

Fig. 2.

Fig. 3.

at two was quite inapplicable, only the general features remaining unaltered.

4. −128°, about 20″ high, forked, thus :—

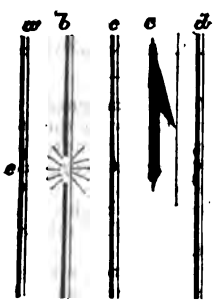
Fig. 4

The structure was *cirrus* in every one but No. 3, which seemed more like a mass of cumulus.

To-day, for the first time, I saw b_1 reversed in the chromosphere when the slit was tangent to disc; 1474 was easy; the new line at 2602 cannot be detected as yet.

At 2.25, while examining the spectrum of a large group of spots near the sun's western limb, my attention was drawn to a peculiar double *knobbiness* of the F line (on the sun's disc, not at the edge), represented by Fig. 5, *a*, at the point *e*. In a very few moments a brilliant spot replaced the knobs, not merely interrupting and reversing the dark line, but blazing like a star near the horizon, only with blue instead of red light; it remained for about two minutes, disappearing, unfortunately, while I was ex-

Fig. 5.



amining the sun's image upon the graduated screen at the slit, in order to fix its position which was at −82½, about 43″ from the edge of the limb, about 15″ inside of the inner edge of the spot-cluster. I do not know, therefore, whether it disappeared instantaneously or gradually, but presume the latter. Fig. 5, *b*, attempts to give an idea of the appearance. When I returned to the eye-piece, I saw what is represented at Fig. 5, *c*, &c. On the upper (more refrangible) edge of F, there seemed to hang a little black mote, making a *barb*, whose point reached nearly to the faint iron line just above F. As given on Angström's atlas, the wave-length of F is 486·07, while that of the iron line referred to is 485·92 (the units being millionths of a millimetre). This shows an absolute change of 0·15 in the wave-length, or a fraction of its whole amount, represented by the decimal 0·00030, and would indicate an advancing velocity of about 55·5 miles per second in the mass of hydrogen whose absorption produced this barbed displacement.

The barb continued visible for about five minutes, gradually resolving itself into three small lumps, one on the upper and two on the lower line, Fig. 5, *d*. In about ten minutes more, the F line resumed its usual appearance. I did not examine the c line, as I did not wish to disturb the adjustments and risk losing some of the curious changes going on under my eye.

After the close of this strange phenomenon, I examined, with our large telescope of 6-inch aperture, the neighbourhood in which this took place, and found a very small spot exceedingly close to, if not actually *at*, the place. This was at 2.45. At 5.30 it had grown considerably.

Undoubtedly, the phenomenon seen was the same referred to by Mr. Lockyer, when he speaks of often seeing the bright lines of the prominences not only at the sun's limb but on his disc. It is the only time I have had the good fortune to see it as yet.

The common fire-fly gives a continuous spectrum without any trace of lines, either bright or dark. It is noteworthy that this spectrum lies almost entirely between the lines C and F, the portion of the luminous diaphason where the thermal and actinic effects are nearly *nil*, and where almost all the energy expended is effective as pure light. How different from our artificial modes, in which not more than one-tenth of one per cent of the expended energy appears as light, the rest being mostly wasted in heat, and partly in actinism.

Hanover, N. H.
September 18th, 1869.

CORRESPONDENCE.

THE ATOMIC THEORY.

To the Editor of the Chemical News.

Sir,—Is it not surprising that, during the recent discussion on Professor Williamson's admirable paper on "The Atomic Theory," no one should have hit upon the simple link which unites the opposing doctrines?

Modern chemistry teaches us that the existence of matter as atoms and molecules is pretty nearly as certain as the existence of matter itself. It is only since that conception has been fully adopted, and by means of it, that chemistry has been raised into an exact science; and the idea involves the indivisibility of the ultimate atom.

On the other hand, mathematical science proves that such a thing as an indivisible atom having size and weight is simply an impossibility; and therefore people fear to accept the theory as absolute truth, but are compelled to use it grudgingly as a temporary expedient.

But why? both sides are correct. The atoms are the ultimate forms of matter *as we know it*, in the form of chemical elements; they cannot be divided, and remain those elements. But no one can affirm, or would think of doing so, that these elements are positively the ultimate forms of matter itself. On the other hand, there is a general feeling, justified by the remarkable relations between the atomic weights and properties of elements, that they are very probably compounds of yet simpler forms of matter, though their decomposition may not be possible to man. The doctrine of atomicity, showing us several centres of force in each atom, confirms this.

Hence, although the chemist can only deal with ascertained facts as a chemist, yet he loses none of his rights to the teachings of mathematics, and is quite entitled to believe that matter may be infinitely divisible and non-atomic in its ultimate essence, and yet be atomic and indivisible in the forms in which he has to deal with it.

May not the interplanetary ether be this ultimate form, and the tremendous actions of the sun, with its vast masses of hydrogen, be a stage of resolution of ordinary elements into this form, to be driven into space, and again condensed into ordinary matter, thus keeping up that circulation of existence which seems to be the fundamental system of Nature?—I am, &c.,

John T. Sprague.

MISCELLANEOUS.

The Royal Society.—The annual meeting of the Fellows of this Society was held on the 30th ult., at Burlington House. The President, Lieut.-General Sir Edward Sabine, K.C.B., &c., delivered the inaugural address, in which he reviewed the progress which had been made in science during the year. The following gentlemen were afterwards elected on the Council for the ensuing year, viz.:—President—Lieut.-General Sir E. Sabine, R.A., K.C.B., D.C.L., LL.D. Treasurer—William A. Miller, M.D., D.C.L., LL.D. Secretaries—William Sharpey, M.D., LL.D.; George G. Stokes, Esq., M.A., D.C.L., LL.D. Foreign Secretary—Professor William Hallows Miller, M.A., LL.D. Other members of the Council—Frederick Currey, M.A.; Warren de la Rue, Ph.D.; Sir Philip de Malpas Grey Egerton, Bart., M.P.; Professor W. H. Flower, F.R.C.S.: William Huggins; John Gwyn Jeffreys; John Marshall, F.R.C.S.; Augustus Matthiessen, Ph.D.; Capt. Richards, R.N.; the Marquis of Salisbury, M.A.; C. W. Siemens; John Simon, F.R.C.S.; Archibald Smith, M.A.; Professor H. J. Stephen Smith, M.A.; Professor John Tyndall, LL.D.; and Professor A. W. Williamson, Ph.D. The Copley Medal was awarded to M. Victor Regnault, for his researches on the specific heat of gases and vapours, &c. A Royal Medal was awarded to Sir Thomas Maclear, the Astronomer-Royal at the Cape of Good Hope, for his measurement of an arc of the meridian. A Royal Medal was also awarded to Dr. Augustus Matthiessen, F.R.S., for his researches on the electrical and other physical properties of metals and their alloys. In the course of his remarks, the President said that Dr. Matthiessen's researches were distinguished, as well for their diversity as for their uniformly complete and trustworthy character, and referred, amongst others, to his investigation of the electric conducting power of commercial copper, which had resulted in very great improvement of the conducting power of the copper wire used in submarine telegraphy. After the meeting, the Fellows and their friends dined together at Willis's Rooms. The senior Fellow of the Royal Society is Sir John F. W. Herschel, Bart., D.C.L., who was First Wrangler and Smith's Prizeman at Cambridge in 1813, and was elected F.R.S. in the same year, being then only twenty-three years of age.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, November 22, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Spectrum of the Planet Neptune, and some Observations on Spectrum Analysis.—Rev. Father Secchi, S.J.—The author first refers briefly to his former observations of the spectrum exhibited by Uranus, and then mainly states that the spectrum of Neptune consists chiefly of three lines, or bands, placed near the green line, and that its light is entirely devoid of red; this is confirmed by the colour exhibited by the planet when seen through a telescope, which is a sea-green. The same author states that, though the night of the 14th of November last, at Rome, was not very favourable for observation of asteroids, on account of the somewhat cloudy sky, he had been enabled to notice more than 180 asteroids during one hour.

Heat given off by the Moon's Rays.—M. Zantedeschi.—From this paper, which is chiefly a review of what has been done by this and other authors in this direction, we learn that, as far back as the years 1685 and 1781, the Italian *savants*, Geminiano, Montanari, and Paolo Frisi, proved the existence of rays of heat emitted by the moon, by means of lenses and ordinary thermometers. The author refers to his observations made some twenty years ago, when he applied thermo-electric apparatus, as well as spirit thermometers and lenses, and obtained results fully confirming those made and recorded by the Italian *savants* just alluded to.

Colouration of Glass under the Influence of Direct Sunlight.—M. Bontemps.—The author, who is the managing director of the celebrated crystal glass works at Choisy le Roi, states, after referring to the observations on this subject made by the immortal Faraday, in 1824, and MM. Gaffield and Pelouze, in 1863 and 1867, that his observations lead to the following results:—Within three months after having been exposed to sunlight, the best and whitest glass made at St. Gobain is turned very distinctly yellow; extra-white glass (of a peculiar mode of manufacture) has become even more yellow, and gradually assumes a colour known as *pelure d'oignon*; glass containing 5 per cent of litharge was also affected, but far less perceptibly; crystal glass, made with carbonate of potassa (the other varieties referred to contain carbonate of soda), litharge, and silica, was not at all affected; English plate-glass, made by the British Plate-Glass Company, and exhibiting a distinctly azure-blue tinge, remained, also, unaffected. The author attributes this colouration, which begins with yellow and gradually turns to violet, passing through red *pelure d'oignon*, to the oxidising effects of the sun's rays upon the protoxides of iron and manganese contained in glass.

Physical Properties of Arable Soil.—M. Hervé-Mangon.—This paper is divided into the following sections:—Microscopical examination of arable soil; determination of the calorific properties of arable soil; condensation of gas in soils; diffusion of gas through soils; tension of aqueous vapour in soils.

Copper Mines of Lake Superior, and Discovery of Tin in the State of Maine, U.S.—M. Jackson.—In the shape of a letter, written by the author to M. Elie de Beaumont, the author states that, in June last, there was found in the Phœnix copper mine, near Lake Superior, a mass of native copper measuring 65 × 32 × 4 feet, weighing 1000 tons, and valued at 400,000 dollars. In some parts, this mass has, instead of its average 4 ft., 7 ft. thickness. As to the site where the tin ore has been discovered, the author states that he received a sample, sent to him from Winslow by a Mr. Moore, and that, on analysis, he (M. Jackson) found the ore to yield, in its crude state, 46 per cent of pure tin, and after washing, about 75·3 per cent. There exist some forty mineral veins containing the ore, and these veins are workable.

New and Important Works.—M. E. de Beaumont.—In his capacity as one of the perpetual secretaries, the author calls particular attention to two works—viz., that of the illustrious geologist and vice-president of the Belgian Senate, M. Omalius d'Halloy, "On the Human Races, or Elements of Ethnography," which is highly eulogised for its clear and distinct language and simplicity of reasoning; and the work of M. Burmeister, "The History of Creation," which has now reached its seventh edition, and is translated into no less than seven different languages, the original being written in German. The eminent perpetual secretary above named speaks of this work as a most masterly exposition of scientific truths placed before the public in a very attractive and pleasant shape.

Revue Hebdomadaire de Chimie, November 11, 1869.

The number contains the following original matter:—

Powders to which Aniline Colours are Added.—M. Méne.—It appears that there are met with in the trade, a series of powders, of comparatively inert nature, with which aniline colours are incorporated. The author says—These substances are chiefly starch, which has been made to absorb alcoholic solutions of the different aniline dyes, and the coloured powders so obtained are employed in the manufacture of coloured printing-inks. As an improved method of the manufacture of such powders (the author says), I employ the following process:—Dissolve, in ½ a kilo. of 95 per cent alcohol, 10 grms. of copal resin and 1 grm. of magenta red; filter the solution, and incorporate therewith, afterwards, so much dry starch as will form a friable uniformly-coloured mass. The mixture is dried in a properly-constructed drying apparatus, and next ground to powder. When a violet tinge is desired, only half the quantity of magenta-red is applied, and the other half replaced by ultramarine. The addition of copal has the effect of fixing the colouring matter to the starch.

A New Kind of Burette.—M. Gondolo.—This piece of apparatus consists essentially of the graduated tube generally applied; but it is improved upon in the following manner:—The internal conical opening at the bottom is shut by a very carefully-ground-in glass plug of conical shape. To this plug is soldered a glass rod, running through the length of the graduated tube, and passing through a cork at the top; in the cork, a spring has been ingeniously placed, in such a manner as to force the glass rod down, and keeping the plug tightly fitting the opening at the bottom. When it is desired to use the burette, which is, of course, firmly fixed in a proper stand, the hand of the operator lifts the end of the glass rod, which projects outside the cork, for a moment, and, on releasing the action of the hand, the plug is shut again by the action of the spring. Provision is made for the admittance of air, of course; and, according to the author's statement, this kind of burette is now very generally in use in France and Germany, and giving great satisfaction to all who use it.

Detection of Adulterations of Soft Soap.—M. Arbelier.—Soft soap is frequently adulterated by the addition of from 20 to 25 per cent of raw starch, with the view of giving to the soap an appearance which, if genuine, is due to solid stearates formed therein. The microscopic investigation will, of course, readily detect this fraud; but if it is required to apply a chemical test, the author states that 10 grms. of the sample of soap should be taken and dissolved, without the application of heat, in alcohol of 85 per cent; the soap, if unadulterated, will be readily dissolved, leaving no residue. If any residue is left, it can be tested by the well-known methods for starch, as well as for other impurities. Lime is sometimes present.

Trade in Flowers Used for Perfumery.—M. Contet.—From this paper we abstract the following:—In order to obtain, by distillation, 1 kilogramme of the undermentioned essential oils, the annexed quantities of parts of plants are required:—Neroli, 100 kilos. of orange blossom; roses, from 10 to 30,000 kilos. of petals of roses; petitgrain, about 500 kilos. of the leaves of the orange-tree; mint, about 500 kilos. of leaves; lavender, about 250 kilos. of flowers; geranium, about 2000 kilos. of the leaves. The extent of the trade of some of these articles may be inferred from the fact that the neighbourhood of Nice alone produces annually a value of £8000 of one single kind of flower, the well-known sweet-smelling Nizza violet. The leaves of the orange-tree are valued at about 20 francs per 100 kilos. Among the perfumes more generally known in Southern than in Northern Europe belongs the *cassies* (*Acacia farnesiana*), frequently used by both French and Spanish ladies to impart a pleasant perfume to their linen.

November 18, 1869.

Preparation of Gilders' Glue.—M. Totin.—Rabbit skins are cut up to shreds as small as vermicelli, and boiled for some time on a water-bath after previous addition of a sufficient quantity of water. The fluid is separated from the portion of the skin insoluble in water by passing through a sieve; and to the fluid, while yet hot, is next added a solution of 100 grms. of sulphate of zinc and 25 grms. of alum, previously dissolved in pure and boiling water. The mixture is thoroughly stirred up and again filtered through a fine sieve; after this, the clear fluid is poured into a suitable vessel, and left to solidify, which takes place after twenty-four hours in winter and forty-eight in summer. When the solidification is complete, the gelatinous mass is cut up into oblong squares and dried, as is usual with glue. When required for use, the dry glue should be soaked first, for about ten hours, in cold water, and next melted by the aid of a water-bath. 1 kilo. of this dried glue yields a thick solution with from 8 to 10 litres of water.

Preparation of Albumen from Blood.—M. Dolfus-Galline.—The increasing demand for albumen, especially for the use of calico-printing (fixing of pigment and other colours), has at various times led to attempts to obtain a supply of this article from the blood of slaughtered oxen and sheep. The author of this paper describes at great length a process invented by him, and actually in operation on the large scale at the *abattoirs* of Dornach, France. The process is based upon the fact of the coagulation of the so-called cruor of the blood, and its separation from the serum thereof, the latter yielding, by cautious management, a dried albumen which can be applied instead of egg albumen for clear and bright colours, while the former may be manufactured into an albumen suitable for dark pigments. 10 litres of serum yield 1 kilo. of dry colourless albumen, and the blood of two-and-a-half oxen yields just sufficient serum to obtain this quantity of albumen; the blood of ten sheep and seventeen calves also produces the same quantity of dry albumen—viz., 1 kilo.

Gas Aérifuge.—M. Rouillé.—The author describes and elucidates, by a woodcut, an apparatus suitable to manufacture gas from the essence of petroleum. In reality, the gas is simply atmospheric air saturated with the vapour of that essence and conducted through pipes. From experiments which are described in this paper, and which appear to have been fairly and scientifically conducted with impartiality, this mode of gas-lighting is fully 21 per cent cheaper than the use of coal-gas, in Paris, for equal illuminating power. The vapour-gas, however, yields a better light; its illuminating power is far greater, for equal consumption, than that of coal-gas, and the products of its combustion are completely free from sulphur and ammonia. The apparatus are simple and efficient, and may be inspected in operation at No. 211, Rue Lafayette, Paris, where, on every Tuesday and Friday evening, the public are admitted to a room purposely fitted up for photometrical and other experiments.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 201, September, 1869.

This periodical contains the following papers and communications bearing upon chemical subjects:—

Researches on the Bleaching of Woven Tissues.—M. Kolb.—There exist in the linen fibre, along with cellulose, two distinct substances—one of these is pectic acid, which is readily and very completely eliminated by alkalies; the other is a colouring substance, which is generated during the roating of the flax, giving thereto a greyish hue, and resisting the solvent action of all known solvents, and only separable from the cellulose by dissolving the latter in the ammonio-copper solution. While the quantity of pectinic products amounts in flax to from 15 to 36 per cent, this greyish matter is present therein in infinitesimal small quantity. Chlorine and hypochlorites discolour this substance, but do not dissolve it; perfect bleaching consists, therefore, in two operations—(1) elimination of all yellow colouring matter by means of alkali; (2) oxidation, and hence decolouration, of the greyish matter, which does not, however, as is generally assumed, thereby become soluble in alkalies. The author proposes the use of dilute liquid ammonia as the best so-called antichlorine, and also because it is simultaneously antacid.

Preservation of Butchers' Meat.—M. Gorges.—The process in use on the large scale by the author at Monte-Video is, briefly, as follows:—The meat, in pieces weighing from 2 to 50 kilos., is placed in a mixture of water (85 per cent) the rest being hydrochloric acid, glycerine, and bisulphite of soda. After having been steeped for some time, the pieces are taken out and dusted over with finely-powdered dry bisulphite of soda, and then packed in air-tight boxes filled as full as possible. In this state, the meat keeps fresh any length of time, and becomes perfectly fit for use—equal to fresh butchers' meat—by steeping for a short time in water to which vinegar has been added, and afterwards exposure to air. The author manufactures, at the place above named, an excellent extract of meat, which can be sold in Europe at 6 francs per kilo.; the price of the preserved meat, of which it would be easy to supply to London and Paris daily over 10 tons, is from 50 to 60 centimes per kilo.

Purification of Sewage Water.—M. Durand-Claye.—From this lengthy paper we quote the fact that the mother liquor of the manufacture of sulphate of alumina clarifies and purifies the liquid in question better than any other substance tried by the authors on the large scale. The expense only amounts to 0·0125 franc per cubic metre of fluid (rather more than 35 English cubic feet).

Cosmos, November 20, 1869.

This number contains the following original matter relating to chemistry and allied sciences:—

Analysis of the Meteorite of Deesa.—M. Domeyko.—This meteorite was observed in Chili, near Santiago, and the author, Inspector-General of Mines to the Republic alluded to, gives, in a lengthy paper, the following chemically-interesting particulars:—The metallic portion of the stone has, at 11°, a specific gravity of 7·51, and consists, in 100 parts, of—Iron, 87·17; nickel, 8·75; insoluble silicate, 2·40; phosphuret of iron and nickel, 1·42. The stony part of this meteorite is exceedingly hard, scratches glass readily, and is not scratched by hardened steel, and assumes a brilliant polish. The sp. gr. of this substance is, at 12°, =3·589; it contains 12·62 per cent of nickeliferous iron. 58·45 per cent is soluble, and 41·55 per cent not soluble in HCl. The insoluble portion consists of—Silica, 18·64; magnesia, 17·89; protoxide of iron, 5·71; traces of soda and alumina; nickelliferous iron, 12·62; troilite, sulphide of iron of meteorites, a peculiar protosulphide of iron, 5·01 (we quote the original exactly, but the total adds up to 59·87, as it is given there). The portion soluble in acid consists of—Silica, 20·79; magnesia, 9·70; protoxide of iron, 6·99; lime, 1·45; trace of soda; alumina, 2·27; peroxide of iron, 0·41; with traces of sesquioxide of chromium, phosphorus, and carbon. The insoluble portion approaches the composition of the peridote, and the soluble portion that of pyroxenic minerals.

Lectures at the Conservatoire des Arts et Métiers, Paris.—While the requirements of technical education are often discussed, many of our readers will, perhaps, be interested with the following list:—Geometry applied to arts; descriptive geometry; mechanics applied to arts; civil architecture; applied natural philosophy; applied chemistry; industrial chemistry; the chemistry of dyeing, glass making, and ceramic art; agricultural chemistry; lectures on the theory of agriculture; agricultural engineering; spinning and weaving; political economy and industrial legislation; industrial economy and statistics. Among the lecturers are MM. Becquerel, Peligot, Tresca, Payen, de Luynes, Boussingault, &c.

Mineral Substances applied for Staining Glass and Porcelain.—M. Meunier.—The colours applied to porcelain and glass are in reality coloured glasses, which are burnt into the mass of the white glass or china. As regards the latter, in most cases, after it has been glazed, since most of the substances used as colouring matter do not stand a very strong heat (technically, in French, *grand feu*)—that is to say, the heat at which the porcelain is fired—the burning-in of the colours is effected in muffles. As colouring matters for porcelain are used:—Peroxide of iron for red (brick), brown, violet, yellow, and sepia; oxide of chromium for green; oxide of cobalt and nitrate of protoxide of cobalt and potassa for blue and black; oxide of uranium for orange and black; oxide of manganese for violet, brown, and black; oxide of iridium for deep-toned black; oxide of titanium for yellow; oxide of antimony for yellow; black oxide of copper for green, and red oxide (suboxide) of copper for red; chromate of lead for yellow; chromate of baryta for yellow; chloride of silver for red; chloride of platinum, and chloride of platinum and ammonium, for steel-colour (in fact, metallic platinum); purple of cassius for purple and rose-red colour. Only the following substances stand, without deterioration or volatilisation, the highest heat of the porcelain furnace (they are *couleurs grand feu*):—The oxides of uranium, cobalt, chromium, manganese, iron (peroxide), and titanium. Most of the substances mentioned are not used as such in pure state, but require either to be mixed very intimately, by a previous ignition with various fluxes, or, also, with other substances, to produce the required hue and shade of colour. The chemistry of the colouring matters required by the artists who paint on porcelain is one of the most difficult and intricate portions of the application of that science to art.

Bayerisches Industrie und Gewerbeblatt, September, 1869.

Among the official announcements in this number, we notice the *series lectionum*, or programme of the winter session of the Royal Polytechnic School at Munich, containing the following sections:—

Mathematical sciences; natural sciences; engineering and architectural science; mechanico-technical science; chemico-technical sciences; general class, including modern foreign languages; drawing class.

Police des Mines et Carrières.—An excellent model of the rules and regulations to be observed for the safety of the working of mines and quarries.

Central Air-Heating Stove.—M. Broc.—There is added to this excellent paper a series of drawings. The stove is designed for heating large buildings, as well as private dwellings, keeping up throughout every part thereof a uniform heat at very little expense.

Precautions Required to be taken by those who Work with Mercury.—Dr. Pappenheim.—This paper is the first instalment of a lengthy memoir on the subject of the volatility of mercury, and on tests for its presence in the atmosphere, especially of workshops. It appears that living plants are so highly sensitive to vapours of mercury that they are the best tests for the purpose of detecting even very minute quantities of the vapours of that metal, especially when the plants are young. The effect of mercury upon plants is the decolouration of all the green parts, especially the leaves.

Utilisation of Scraps of Tinned Iron.—M. Bock.—The scraps are placed in a tank made of stout sheet iron. To 1 cwt. of scraps, 6 lbs. of flowers of sulphur, 10 lbs. of caustic soda, and a quantity of water are added, and the mixture brought to ebullition by means of steam, introduced into the tank by means of a suitable pipe. The boiling is continued for about half an hour; the liquor is filtered, evaporated to dryness, and ignited with access of air. The ignited mass is lixiviated with water, yielding stannate of soda and sulphate of soda, which are separated from each other by their different degrees of solubility; both salts crystallise.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, September, 1869.

This number contains the following original papers and communications:—

Some Little-Known Poisonous Mexican Plants belonging to the Order of Compositæ.—Dr. Huseman.—It appears that the plant known as *Its cuimpatli, Yerba de Puebla, Senecio canicida*, has been submitted to a chemical investigation by the Mexican chemist, De la Loza; he detected a peculiar organic acid, which he called senecic acid. This acid should, according to this chemist, possess poisonous properties; it forms, with potassa and ammonia, deliquescent salts; neither the acid itself, nor its alkaline salts, are precipitated by the soluble salts of lime, magnesia, mercury, silver, copper, and platinum. The acid is soluble in alcohol, and is obtained by treating a decoction of the plant with acetate of lead and removal of the excess of lead by means of dilute sulphuric acid; the fluid so obtained, after filtration, is evaporated to the consistency of a syrup, and left standing for a few days. The acid separates in small, but deliquescent crystals; these are collected and purified by treatment with strong alcohol. The acid and its salts are very poisonous; but the plant and its alcoholic extract are used in Mexico as a powerful febrifuge and anthelmintic.

Contributions to the Search for, and Detection of Blood-Stains.—M. Hirsch.—There is nothing in this paper which is not well-known to all who, in their capacity as forensic chemists, may have to deal with this subject.

Testing Antimony for Arsenic by the Moist Way.—M. Rump.—The author states—During the latter end of last year, on the occasion of the inspection of apothecaries' shops in Prussia, a quantity of tartar emetic was found to contain arsenic; as a consequence thereof, a report was made to head-quarters, at Berlin, and a rigorous inquiry and investigation set on foot by order of Dr. de Mühler, as minister for medical affairs and police (*medizinal polizei*). The methods of testing for arsenic, when mixed up with antimonial preparations, were carefully considered, and the following method of testing, due to the researches of Mine Inspector Strohmeyer, adopted:—2 grms. of the suspected tartar emetic are reduced to a fine powder and dissolved in 4 grms. of pure hydrochloric acid (sp. gr., 1·124). The glass vessel wherein this solution is made ought to be narrow, and capable of being well closed, and of sufficient size to contain an additional quantity of at least 30 grms. more of hydrochloric acid. A quantity of pure hydrochloric acid should be thoroughly saturated with sulphuretted hydrogen gas, and of this acid a quantity of at least 30 grms. is added to the solution of the tartar emetic. The glass vessel containing the solution is well corked, and, after having been shaken up, set aside; the turbidity which at first appears soon subsides (if it does not do so, it is due to the too great saturation of the HCl with HS, and should be remedied by the addition of some pure HCl). If no arsenic is present at all, the liquid remains perfectly colourless; but the slightest trace of arsenic gives rise to a yellow colouration, and very soon after to a perfectly perceptible pure yellow precipitate of sulphuret of arsenic.

Zeitschrift für Chemie von Beilstein, No. 20, 1869.

On Phosphamides.—M. Schiff.—After briefly referring to his former experiments on this subject, and commenting, in a few words, on Dr. Gladstone's treatise on the action of ammonia upon oxychloride of phosphorus, the author says—When perfectly dry ammonia gas is brought into contact with oxychloride of phosphorus, so much heat is at first set free that it is necessary to moderate the action considerably; but it is not possible to eliminate the whole of the chlorine, unless the product first obtained be repeatedly treated with ammonia. The chloride of ammonium can be removed by hot water, since neither that fluid, nor, also, dilute acids, have any decomposing effect upon the triamide thus formed. When phosphotriamide is heated without access of air, it is converted into monophosphamide, NPO, the loss of weight amounting to about 36 per cent. It is clear that only ammonia is disengaged, and no vapours of chloride of ammonium are detected at all, which would certainly make their appearance if a chlorinated amide were dealt with. When phosphoric acid is considered as—

$$P\begin{cases}O.OH\\OH\\OH\end{cases}$$

and the oxychloride of phosphorus as—

$$P\begin{cases}O.Cl\\Cl\\Cl\end{cases}$$

the meaning is that one of the atoms of chlorine has a different chemical function than the two other atoms; and it is just possible that that very one atom is less readily acted upon than the rest. When pentachloride of phosphorus is suffered to act upon aniline, a rather violent reaction takes place; but, with careful management, a whitish-coloured substance, insoluble, and thereby undecomposable in cold water and dilute acids, is obtained; when, however, this substance is boiled with water, it is split up, and phosphate of aniline is among the products of decomposition. The original product is phosphodianilide—

$$N_2\begin{cases}PO\\3C_6H_5\end{cases}$$

and its formation is represented as follows:—1. First action of aniline and pentachloride of phosphorus—

$$PCl_5+3C_6H_7N=N_2\left\{\begin{matrix}PCl_3\\3C_6H_5\end{matrix}\right\}+NH_4Cl+2HCl.$$

2. On being next treated with water—

$$N_2\left\{\begin{matrix}PCl_3\\3C_6H_5\end{matrix}\right\}+H_2O=N_2\left\{\begin{matrix}PO\\3C_6H_5\end{matrix}\right\}+2HCl.$$

Cyantoluylen.—M. Irelan.—The author has investigated the behaviour of chlorotoluol-sulphate of potassa towards cyanide of potassium. When an intimate mixture of these salts is heated, a sublimate is obtained, exhibiting, after re-crystallisation from alcohol, a solid substance forming needle-shaped crystals composed according to the formula—

$$C_9H_6N_2=C_7H_6\begin{cases}CN\\CN\end{cases}$$

On being boiled with a solution of caustic potassa, ammonia is given off, and if, afterwards, sulphuric acid is added, a dicarbon acid (*dicarbonsäure*) is precipitated, which acid is, in all probability, uvitinic acid. Dichlorotoluolsulpho acid yields, when submitted to the same treatment, a cyanised compound.

Behaviour of Epichlorhydrine towards Neutral Sulphate of Potassa and Cyanide of Potassium.—M. Paraschke.—On mixing 1 molecule of epichlorhydrine and 1 molecule of K_2SO_3 in concentrated aqueous solution, and boiling the mixture, a deep yellow-coloured, acrid-smelling fluid was obtained, which solidified on cooling, yielding a crystalline compound, which, after having been repeatedly re-crystallised, yielded a salt, $C_5H_9S_2O_7K_2+2H_2O$; that is to say, disulphoglycerinate of potassa. The reaction of neutral sulphate of potassa upon epichlorhydrin is rather complex, and exhibits two different stages;—

1. $\left.\begin{matrix}CH_2\\CH_2O\\Cl\end{matrix}\right\}C+2\left(\begin{matrix}KO\\KO(SO)\end{matrix}\right)=\left\{\begin{matrix}CH_2K\\CH_2O\end{matrix}\right\}C\left(\begin{matrix}(SO_2)\\(SO_2)\end{matrix}\right)\begin{matrix}OK\\OK\end{matrix}\Big\}+KCl.$

2. $\left.\begin{matrix}CH_2K\\CH_2O\end{matrix}\right\}C\left(\begin{matrix}(SO_2)\\(SO_2)\end{matrix}\right)\begin{matrix}OK\\OK\end{matrix}\Big\}+H_2O=\left\{\begin{matrix}CH_2\\CH_2O\end{matrix}\right\}C\left(\begin{matrix}(SO_2)\\(SO_2)\end{matrix}\right)\begin{matrix}OK\\OK\end{matrix}\Big\}+KOH.$

When 20 grms. of epichlorhydrine were gently heated along with an aqueous solution of cyanide of potassium (15 grms. KCy, and 60 grms. H_2O), a rather violent reaction sets in; but, with proper management, a crystalline compound is obtained, which is readily dissolved by water and alcohol, but sparingly by ether; this substance is composed according to the formula C_4H_5NO.

Identity of Dichlorhydrine obtained from Glycerine and Epichlorhydrine.—The author has compared dichlorhydrine, prepared by passing hydrochloric acid gas into a mixture of four parts of glycerine and three parts of glacial acetic acid, with the dichlorhydrine prepared by passing hydrochloric acid gas into epichlorhydrine. The former boils at from 176° to 177°, and has a sp. gr. of 1·366 at 17·5°; the latter boils at from 175° to 176°, and has, at 17·5°, the very same density as just mentioned. They are both equally soluble in water.

Dicyannaphthaline.—MM. Baltzer and Merz.—When dipotassium-disulphonaphthalate is submitted to distillation with excess of cyanide of potassium, a fluid is obtained which solidifies in the neck of the retort. This crude substance contains two dicyannaphthalines, of different solubility in alcohol. The more readily soluble of the two exhibits, after having been purified, a silky-looking, needle-shaped, crystalline mass, devoid of taste and smell, and fusing at 181°; this substance is completely decomposed at about 200°, and the action of either aqueous solution of caustic potassa or hydrochloric acid yielding, in each instance naphthalin-dicarboxylic acid, a beautifully crystalline compound. The other dicyannaphthaline, far less soluble in alcohol (boiling only), fuses at 260°, is a crystalline compound, and undoubtedly identical with a substance obtained by MM. Darmstädter and Wichelhaus from dinaphthalin-disulpho acid.

Isomeric Cresoles and their Derivatives.—MM. Engelhardt and Latschinoff.—This lengthy memoir opens with an introduction

reviewing the labours of so large a number of scientific chemists who have experimented on this subject, that their names alone would fill a too considerable space. Of the paper itself, we can only give the titles of the headings of its different sections:—Isomeric toluolsulpho acids, $C_7H_7(HSO_3)$; α and β toluolsulpho salts; isomeric cresoles, C_7H_8O; α cresole; α benzoyl-cresole, $C_7H_7O(C_7H_6O)$; α ethyl-cresole; α cresol-sulpho acid; α cresol-sulpho-potassium, $C_7H_6(KSO_3)OH+2H_2O$, and a series of similar salts of various bases; α cresol-disulpho acid; α cresol-disulpho-potassium—

$$C_7H_5(KSO_3)_2OH+3H_2O;$$

β cresole, C_7H_8O; β benzoyl-cresole; β cresol-sulpho acid; γ cresole, C_7H_8O; γ benzoyl-cresole, $C_7H_7O(C_7H_6O)$; γ ethyl-cresole; γ cresol-sulpho acid; isomeric cresotinic acids, $C_8H_8O_3$; isomeric toluylic acids. The memoir is an abstract from a very lengthy paper published in the Russian language, and is so full of formulæ and references to different papers published on this subject that it is not possible to enter into more details here.

Some of the Products of Decomposition of Trichloromethylsulphurous Acid.—M. Loew.—When trichloromethylsulphobromide is submitted, in alcoholic solution, to a temperature of about 110°, while enclosed in a sealed tube, and the contents of the tube are next diluted with water, a heavy oil is separated, while the supernatant liquid contains free sulphurous acid; this reaction takes place according to the following equation:—

$$\underbrace{(CCl_3)[SO_2]Br}_{\text{Trichloromethyl-sulphonbromide.}} = \underbrace{CCl_3Br+SO_2}_{\text{Carbontrichloro-bromide.}}.$$

Along with the sulphurous acid, a small quantity of trichloromethylsulphonic acid is detected. Carbontrichlorobromide boils at 98°, and is, when passed through a dull red-hot combustion tube, decomposed into bromine and solid chloride of carbon. The author did not succeed in obtaining the analogous iodide; neither did he obtain a trichloromethyl-sulpho urea. While attempting to prepare dichloromethylen-sulphon, by submitting trichloromethylsulphinate of sodium to destructive distillation, according to the formula—

$$(CCl_3)[SO]ONa=NaCl+(CCl_3)[SO_2],$$

a very small quantity of that substance was obtained; but the reaction went further, and other substances, among which, perchloride of ethylen, were obtained, this reaction being represented by—

$$2((CCl_3)[SO_2])=2SO_2+C_2Cl_4.$$

Action of Direct Sunlight upon Iodide of Potassium.—M. Loew.—A solution of iodide of potassium is, even when kept in well-closed bottles, slowly decomposed by the action of daylight, and assumes a somewhat yellowish tinge, due to free iodine. The author filled a number of glass tubes for about from one-half to three-fourths of their capacity, with a solution of iodide of potassium, and, after having sealed these tubes, exposed them to direct sunlight. Another set of tubes were likewise filled with the same solution, but all air was expelled, and the tubes sealed during and after the solution had been boiling for a considerable time. These tubes were also exposed to the action of direct sunlight; after three and four months' exposure, the tubes and contents were examined; those wherein no air at all was left were found to be perfectly colourless, no decomposition of the contents having taken place. As regards the other tubes, the following results are noticed:—(1) Under the influence of light, the oxygen of the air decomposes iodide of potassium, iodine in small quantity is set free, while hydrate of potassa is found in the liquid. (2) This decomposition is limited, and does not, even when a large quantity of oxygen is present, increase, because a portion of the iodine set free enters again into combination with the caustic potassa set free, forming iodide of potassium and iodate of potassa. (3) The testing for ozone by means of a solution of iodide of potassium and starch (or paper prepared therewith) is of no value whatever, unless care has been taken to exclude direct sunlight.

Precipitation of Cobalt by Sulphuretted Hydrogen, and Purification of Salts of Manganese containing Cobalt.—M. Muck.—The gist of this paper is that boiling-hot solutions of cobalt are, even when free acid is present, readily precipitated by sulphuretted hydrogen. When there is added to such a solution carbonate of manganese, in sufficient quantity, the sulphide of cobalt is completely precipitated, and, after elimination of the free HS, a pure solution of manganese is obtained. The author also states that there occur many ores of manganese which contain large quantities of cobalt ore.

Phenol from Oxybenzoic Acid.—M. Rosenthal.—The author has prepared phenol by distilling oxybenzoic acid with lime; and, on investigation, found it to be in all respects identical with the phenols obtained from tar, salicylic acid, and paraoxybenzoic acid.

Ethyloxybenzoic Acid.—M. Rosenthal.—The author says—I tried to prepare, from oxybenzoic acid, an acid of the formula—

$$C_6H_3\begin{cases}OH\\COOH\\COOH\end{cases}$$

by causing carbonic acid and sodium to act upon the compound—

$$C_6H_4\begin{cases}OH\\COOC_4H_5.\end{cases}$$

Instead of obtaining the desired result, the author obtained the compound—

$$C_6H_4\begin{cases}OC_2H_5\\COOH\end{cases}$$

which is undoubtedly due to the conversion of Na and C_2H_5; this substance is ethyloxybenzoic acid, and was, on comparison, found to be in every respect identical with the compound obtained by heating oxybenzoic acid with KHO and C_2H_5I.

Les Mondes, November 18, 1869.

Refined Resin Oil.—M. Curie.—When resin is submitted to destructive distillation, it yields various oils of different specific gravity, acetic and phenic acids, water, tar, and gases; the crude oil is often applied for the making of printing-ink, as well as waggon grease. The author treats the crude oils, tar inclusive, with lime, and, by fractioned distillation between 140° and 260°, obtains what is known as essence of resin. At 370°, an oil is obtained which, for lubricating purposes, is nearly as good as best olive oil, and is an excellent substitute for turpe in oil-paints. This oil is sold at Bordeaux at 50 francs (£2) per 100 kilos.

Treatment of the Sewage of the City of Rheims.—MM. Houzeau, Devédeix, and Holden.—In a lengthy paper, the authors detail the results of a series of experiments made on a sufficiently large scale to form a proper opinion as to the value and permanent applicability. The processes which have been applied are:—(1) Treatment with sulphate of iron and lime; (2) treatment with lignite and lime; (3) treatment with small coal (dust, rather) and a small quantity of sulphate of iron and lime. The two first processes yield a manure; the last a fuel. The city of Rheims is situated on and near the banks of the Vesle, and contains, exclusive of the large garrison, a population of about 61,000 inhabitants. According to a report of M. Marisdort, Professor of Chemistry at this place, the process, by means of the use of lignite, is a complete success.

NOTES AND QUERIES.

Reducing the Metal from Impure Chloride of Zinc.—Can any of your readers inform me of a practical and profitable method of reducing the metal from impure chloride of zinc?—AN OLD SUBSCRIBER.

Aluminium Sulphide and Phosphide.—(Reply to "D. H.")—See Berzelius's "Traité de Chimie," vol. ii., p. 157 (Paris, 1846), and "Handbook of Chemistry," by Gmelin, vol. iii., pp. 309 and 311. Both works may be inspected at the Library of the Commissioners of Patents.

Atomicity of Aluminium.—(Reply to "Dubitans.")—Aluminium is tetratomic and pseudo-triatomic, like carbon. In the simplest formulæ of aluminium compounds, the metal is represented as triatomic, as, for example, $Al^{iv}Cl_3$ $Al^{iv}K'2SO_4+12H_2O$; but the specific gravity of the vapour of aluminium chloride shows that the true formula is Al_2Cl_6, and not $AlCl_3$. Hence it is probable that each aluminium atom is really tetratomic, the constitution of the chloride being—

$$\begin{array}{l}Al^{iv}\!=\!Cl_2\\|\\Al^{iv}\!-\!Cl_2\end{array}$$

—ATOMICITY.

Gas and Oil Furnaces.—No one seems inclined to give me the information as to getting up white heats in a small furnace with ordinary gas from the mains, from which I infer no one of the readers of the CHEMICAL NEWS has done it, nor sees his way how to do it. As I find, on inquiry at the gas office here (Runcorn), that they will not allow any reduction in price for use in such quantity, save some 2½ discount, I must try oil of some sort or other. Which is best for my purpose? I want to have as *clean* a heat as possible—that is, free from sulphur and deposit of any kind that would interfere with the action of the vapours I introduced on the clay goods in the kiln. At first thought, you would fancy a flame from oil should not leave any deposit; but I am not so sure, as the gas from a gas producer of Siemens's covered the goods with brown-red dust.—J. C.

MEETINGS FOR THE WEEK.

MONDAY, Dec. 6th.—Royal Institution, 2. General Monthly Meeting.
—— Medical, 8.
—— London Institution, 4.
WEDNESDAY, 8th.—Society of Arts, 8.
—— Geological, 8.
—— Microscopical, 8.
THURSDAY, 9th.—London Institution, 7.30.
—— Royal, 8.30.
—— Zoological, 8.30.
—— Royal Society Club, 6.
FRIDAY, 10th.—Quekett Club, 8.

TO CORRESPONDENTS.

R. K.—Picrate of potash explodes on concussion; detonation is greatly increased by the addition of chlorate of potash.

T. C. Winton, A.B., M.D.—Victoria orange may be obtained of Messrs. Roberts, Dale, and Co., Manchester.

Librum.—Fresenius's "Qualitative and Quantitative Analysis," published by Churchill.

R. H.—Any person can receive fees as an analyst without passing an examination or proving his competency.

Captain Rose, R.A.—We regret that we have no space for your articles. They will be returned to any address you may forward.

THE CHEMICAL NEWS.

VOL. XX. No. 524.

ON THE

CONSTITUTION OF SODIC SULPHATE IN SOLUTION.

By CHARLES TOMLINSON, F.R.S.

II. LÖWEL'S HYPOTHESIS—ANOTHER HYPOTHESIS.

As there is no harder or pleasanter intellectual work than original research, so there is no harder or more unpleasant moral work than having to modify or re-construct one's own theory after having spent years of toil in establishing it, and even after it has been accepted with applause by competent critics. This is what M. Löwel has done; and I cannot sufficiently honour and respect him for his candour in having been the first to awake to the sense of his own defects, and to wind up his work by saying so.

As already stated, his first five memoirs were published between 1850 and 1855. In his sixth and last memoir, published in 1857, he is led, chiefly by three considerations, to suppose that, between the boiling point of a saturated solution of sodic sulphate (103·17° C.) and the point when the 7-atom salt begins to be deposited (18°), it is not this modified salt, but the anhydrous variety, that is held in solution. His reasons are the following:—

1. That the 10-atom salt parts so readily with its water of crystallisation by mere exposure to the air at temperatures between 15° and 20° C.

2. That Faraday found, on evaporating a solution of the 10-atom salt below 100° C. (or, according to Mitscherlich, below 40°), the anhydrous salt was deposited.

3. That, in boiling for some time a saturated solution of the 10-atom salt, small, hard, granular crystals of the anhydrous salt are formed as the solution becomes concentrated.

But M. Löwel cannot get rid altogether of his molecular theory. Although he admits that, between the boiling point of a saturated solution (103·17° C.) and the point when the modified salt begins to be formed (18°), the anhydrous salt is held in solution, yet, at and below 18°, a molecular change comes over the solution, by virtue of which it holds or begins to deposit the 7-atom salt.

In weaker solutions, it is admitted that this molecular change takes place at yet lower temperatures. A boiling solution of 2 parts of the 10-atom salt to 1 part of water, for example, must be cooled to 7° or 8° C. before it deposits the modified salt; while a solution of 1 part salt to 1 part of water must be reduced to 0° before the 7-atom salt is deposited. Hence the 7-atom salt is not deposited at the same temperature, but at very different temperatures, low in proportion as there are fewer saline molecules in solution. He admits that it was an error to suppose the 7-atom salt to be already formed, since such solutions do not begin to deposit the modified salt as soon as the temperature passes below the point at which the solutions would be saturated with that salt if it were really present. Thus the boiling saturated solution would be saturated with the 7-atom salt at about 26° C., and it did not begin to deposit that salt under 17° or 18°. The weaker solution (2 salt to 1 water) would, in like manner, be saturated at 18°; but it was reduced to 8° before the 7-atom salt appeared; while the still weaker solution (1 salt to 1 water) required a reduction of temperature equal to 0°. The first solution evidently contained anhydrous salt up to the very moment when it began to deposit the 7-atom salt; and there is no reason to suppose the other two solutions, although much less rich in salt, to have been differently constituted. Moreover, when the second solution has deposited the 7-atom salt at 7° or 8°, so long as it remains in contact with these crystals, it possesses fixed points or terms of saturation, limited by the temperature—that is, it deposits the 7-atom salt when its temperature is reduced, and it re-dissolves it to saturation when the temperature rises; but, if this elevation of temperature reach to 22° or 24°, so that the 7-atom salt is totally dissolved, the solution will not deposit crystals when the temperature again falls a little below 18°, but it must be lowered to 8° or 7°, just as if it had not deposited salt at all. "Hence," he says, "I conclude that the 10-atom salt, as well as the 7-atom salt, in passing into solution, at whatever temperature, gives up the whole of its water of crystallisation. Under what conditions, then, are these salts in solution? I can only give hypotheses; and, without seeking to define this condition, it may be best to say that, in passing into solution, they assume an indeterminate molecular constitution, which may be termed the molecular constitution of sulphate of soda in solution, which differs from the molecular constitution of the crystals of the 10-atom, the 7-atom, and the anhydrous salt."

Löwel has given very full tables of the solubility of each of the three forms of sodic sulphate at various temperatures, and his determinations extend to two places of decimals. "I could not," he says, "determine the point of maximum solubility of the anhydrous salt at temperatures below which it begins to deposit the 7-atom salt. At 18°, the change of state is made suddenly; the solutions become troubled, and deposit crystals of the 7-atom salt in a pulverulent form."

Here I venture to think M. Löwel missed his opportunity. If, instead of depositing "crystals of the 7-atom salt," he could have written, "the anhydrous salt," he would have saved himself from much embarrassment, and the present discussion would have been unnecessary.

It was in repeating some of M. Löwel's experiments during the cold weather of December, 1867, that I observed the sudden troubling of the solution. A stream of nearly ice-cold water was allowed to run upon a flask containing a warm supersaturated solution of sodic sulphate, when it suddenly became opaque, from the formation of a multitude of minute crystals, which seemed to increase in number on gently shaking the flask. On repeating the experiment with more care with solutions in test-tubes placed in transparent freezing mixtures, these crystals were soon recognised as the octohedra of the anhydrous salt. I will quote from my note-book a few out of many of the experiments that were made to determine what seemed to me to be a very important point; for it was this experiment that first led me to question the integrity of the molecular theory, as well as the reality of the so-called catalytic action of the sides of the flasks and of solid nuclei.

A solution of 3 parts of the 10-atom salt to 1 part of distilled water was boiled at 218° F., when a small portion of anhydrous salt was thrown down. The solution was filtered into a flask, in which it was again boiled. The flask was then plugged, with a thermometer passing through the plug. When the solution had cooled down to the temperature of the room, the flask was put into cold water. At 54°, a few well-shaped, sharply-cut, octohedra began to fall. At 50°, the number of crystals had so greatly increased as to render the solution opaque; heat currents were liberated, and the temperature rose to 58°.

Two parts of the 10-atom salt to 1 part water: octohedral crystals began to form at 48°.

One part salt to 1 of water: at 35°, a few well-shaped octohedral crystals were thrown down.

So far, then, it seemed to me to be perfectly well made out that the 10-atom salt, in passing into solution, gives up the whole of its water of crystallisation to the solvent. In heating the solutions, a dendritic crystallisation of the anhydrous salt creeps up the side of the flask just above the level of the solution; and, in filtering strong solutions,

a thin anhydrous crust forms on the surface of the liquid in the filter. The proofs are manifold that the anhydrous salt is in solution; but the most convincing proof of the fact seems to me to be the throwing down of anhydrous crystals on lowering the temperature of the solutions to a sufficient degree.

The abrupt change that takes place in the curve of solubility of the 10-atom salt at 33° or 34° C. was pointed out by Gay Lussac, and explained by him that, whereas it is the saline molecule $NaO,SO_3+10Aq.$ that enters into solution, yet, beyond this point, when the solubility diminishes up to boiling, it is the anhydrous salt that is in solution.

Löwel remarks on this:—"We can easily explain why the solubility of sulphate of soda presents this curious anomaly of increasing with the temperature up to a certain maximum, and then diminishing as the temperature rises. So long as the salt is in the form of 10-atom crystals, its solubility increases from 0° to 34° C. Above 34°, this salt no longer exists; it becomes anhydrous, with a different molecular constitution and solubility. The solubility of the anhydrous salt follows an inverse order as compared with that of the 10-atom hydrate. It diminishes in proportion as the temperature rises, or, what is the same thing, it increases as the temperature falls from 103·17° (the boiling point of a saturated solution), not only to 34°, but also to 18° and 17°, when the dissolved salt undergoes a new modification in its molecular constitution, and begins to form crystals of the 7-atom hydrate."

Now, if it be true that the 10-atom hydrate remains in solution up to 34° C. (93·2 F.), solutions made below that temperature ought to deposit the 10-atom salt on cooling in close vessels, just as they do in open vessels where they are in contact with nuclei; but the fact is, such solutions still deposit the anhydrous salt. Solutions saturated at about 85°, or from that to 88° F., and filtered into flasks warmed to that point, and then plugged, were kept until the next day, without any deposit of salt. On detaining them for some time in a freezing mixture, at from 16° to 25° F., they sometimes froze, but, on several occasions, they threw down small, well-defined crystals of the anhydrous salt. Hence, it cannot be true that, up to 34° C., it is the 10-atom salt that is held in solution.

There remains still one point to be discussed. M. Löwel supposes that the supersaturated solutions, in cooling to 18° or 17° C. (64·4 to 62·6 F.), assume the molecular constitution of the 7-atom hydrate; and, further, that, when this salt is deposited, the non-crystallised portion of the solution is the mother liquor of the 7-atom salt. He determines the solubility of this 7-atom hydrate by carefully withdrawing, by means of a warm pipette, a little of the so-called mother liquor at a known temperature, weighing it, evaporating it to dryness, and so calculating the solubility of the 7-atom salt in terms of the anhydrous salt obtained by the evaporation.

But, suppose the so-called mother liquor resting on crystals of the 7-atom salt is once more a solution of the anhydrous salt, what then becomes of the table of solubilities? and what of the theory of molecular change at 17° or 18° C.?

I made a solution of about 2½ parts of the 10-atom hydrate in one part of water; boiled it, and filtered it into three test-tubes, which were then plugged with cotton-wool, and placed upright in a rack close to the window to cool. They were then put into water at from 35° to 40° F., when octohedral crystals of the anhydrous salt were deposited in all three solutions. The tubes were now returned to the rack, when, in a few hours, the 7-atom salt was formed, a few prisms with oblique summits being well marked. The tubes were now put into a freezing mixture, at 20° F., when another shower of beautiful octohedra took place. I need hardly say that, if the molecular change insisted on by M. Löwel had taken place, and if the solution resting on the 7-atom hydrate had been its mother liquor, crystals of the 7-atom hydrate must have been thrown down, and not those of the anhydrous salt.

The tubes were again returned to the rack; when, after some time, another formation of the 7-atom hydrate took place. Next day, in order to be quite sure that it was the 7-atom salt at the bottom of the tubes, the cotton-wool plug was removed from one of them, when crystallisation of the 10-atom salt at once set in from the surface, and, proceeding downwards, converted the deposit into an opaque, chalky mass, or, as Ziz says, "like boiled white of egg," the crystallisation above it being translucent, like ground glass. The two remaining tubes were put into a freezing mixture at about 10° F. The crystals were long in coming, but at length a few well-defined octohedra fell down from the solution in each tube.

I remember that Professor Daniell, of King's College, was in the habit of introducing the same experiment, under different forms, even to variations in the shape of a bottle or flask, in order that his pupils might be allured by the principle involved, rather than by the form of the apparatus. Profiting by this useful example, I prepared a solution of about 4 salt to 1 water, in flasks, where, with much less depth, there was a greater body of solution than in the tubes. The flasks were exposed to the cold of the window-ledge, where they remained all night. Next morning, there was a copious deposit of the 7-atom salt. On putting one of the flasks into a freezing mixture, at 25° F., there was an abundant liberation of anhydrous crystals from the so-called mother liquor of the 7-atom salt, but which is really a solution of the anhydrous salt.

I ought, perhaps, to apologise for drawing thus freely on my note-books for these experiments. My best excuse is that they have not been previously published. In my memoir on "Supersaturated Saline Solutions," I was satisfied with the statement, accompanied by one experiment only, that solutions of Glauber's salt, when removed from the influence of nuclei, hold anhydrous salt in solution, and deposit it on a proper reduction of temperature. Such was my conclusion two years ago; and I see no reason to alter my opinion now. On the contrary, that opinion is strengthened by experience, and by recurring to Professor Daniell's favourite process of varying and multiplying the means, so as to become more secure of the end. One such variation I cannot help giving, since it leads to the same conclusion, by means of a physical test of great practical value.

In the experiments for determining the elasticity of steam from pure water, the elasticity is diminished for any given temperature, if a small portion of a salt, soluble in water and not capable of rising in vapour with it, be allowed to ascend to the top of the mercurial column, the column rises, thereby indicating a diminished elasticity of the steam. The adhesion of the soda to the water tends to restrain the water from evaporating, and this tendency is a measurable force, and here measured; for it partly balances the tension of the water, or its tendency to emit steam, and thus makes the steam-emitting tension of a solution of soda measurably less than that of pure water at the same temperature.

Now, it is clear that, if, instead of soda, Glauber's salt be used in experiments of this kind, there would be a smaller amount of diminution in the elasticity of the steam if the salt in solution retained its water of crystallisation than if it entered into solution in the anhydrous form. In a valuable series of experiments by Wüllner,* it appears to have been established that, for solutions of various strengths (such as 10, 20, 30, &c., per cent of Glauber's salt in pure water), and at various temperatures, from 10° to 100° C., the diminution in the elasticity of the steam is proportional to the quantity of *dry* salt in solution; and, further, that, at the point of maximum solubility of this salt, no molecular change takes place, or it would have impressed itself on the curve which represents the elasticity of the steam. The general conclusion for the salts tried is that the action of efflorescent salts is

* *Pogg. Ann.*, ciii., 529, and cx., 564.

expressed in terms of the dry salt, while, for deliquescent salts, it is in terms of the hydrated salt.

I cannot wind up without entering a protest against the doctrine involved in the foot-note to M. Dubrunfaut's paper (CHEMICAL NEWS, vol. xx., p. 241), which amounts to this—that, if a man repeat the published experiments of others without knowing it, he is entitled to claim the results as original discoveries of his own. I am quite aware that credit is given to M. Löwel in our text-books for discoveries that belong to previous inquirers; and, with all due respect for him, I cannot help thinking that he would have improved his work by quoting his authorities more freely. Now, at the time when Löwel commenced his labours, a large number of well-attested facts had been established by such men as Ziz, Ogden, Faraday, Turner, Graham, and others. Löwel does refer incidentally to Ziz and Faraday, proving that he knew something of their results; and yet we are now coolly told that all those honoured names are to be swept away, and Löwel only referred to as the discoverer of the leading phenomena of supersaturation. If such reasoning and practice were applied in literature as they are on some occasions in science and the useful arts, we should realise the condition of the modern epic poet, who declared that he had splendid thoughts, only those scoundrels, the Ancients, had already appropriated them.

Highgate, N., November 24th, 1869.

ON SOME

TECHNICAL APPLICATIONS OF THE SPECTRUM MICROSCOPE.*

By H. C. SORBY, F.R.S., &c.

MY object in publishing the following paper is to show that the spectrum microscope may be applied with advantage in several departments of technical inquiry, and more especially to describe the methods useful in such investigations. Since these will be much more readily understood by means of practical illustrations, I shall not make many general introductory remarks, but reserve an account of each particular process until I come to those practical questions which require its adoption.

In the first place, I beg to refer to my papers "On a Definite Method of Qualitative Analysis of Animal and Vegetable Colouring Matters,"† and "On the Colouring Matters of Blue Decayed Wood,"‡ since much that I shall describe will be a continuation and application of what they contain. I shall make use of the same scale for measuring the position of the absorption bands, and the same notation and symbols to express the varying power of absorption in different parts. This scale is an interference spectrum with dark bands, which divide the whole visible spectrum into twelve portions of equal optical value; and it is so adjusted that the sodium line, D, is situated exactly at $3\frac{1}{2}$. On this scale the principal Fraunhofer lines occur as follows:—

A .. $\frac{2}{3}$	B .. $1\frac{1}{2}$	C .. $2\frac{5}{8}$	D .. $3\frac{1}{2}$
E .. $5\frac{11}{16}$	*b* .. $6\frac{5}{16}$	F .. $7\frac{1}{2}$	G .. $10\frac{1}{2}$

The only objection to this scale is that its accuracy is dependent on the careful preparation of the plate of quartz. I have myself made several perfectly alike and accurate, and nothing but proper care is required. When once accurately made, no scale could be more convenient, since the bands occur at equal optical intervals over the whole spectrum, and are quite distinct when the slit is opened rather wide, which is sometimes a great advantage. In these two respects it is far superior to any other scale hitherto proposed.

The intensity of absorption will be expressed by means of dots, hyphens, and dashes; thus:—

Not at all shaded		Blank space.
Very slightly shaded	.	Single dot.
Slightly shaded	..	Double dots.
Moderately dark	– –	Double hyphens.
Very dark	—	Single dash.

When these symbols are printed *between* numbers they signify that there is a more or less strong absorption between those points of the spectrum as measured by the above-named scale; whereas when they are printed *under* numbers they signify that there is a distinct absorption band, of the intensity expressed by the different symbols, the *centre* of which is situated at that point of the scale indicated by the figures. This latter method is extremely simple and convenient, and often serves to express all that is requisite. It may, perhaps, appear imperfect to those accustomed to the study of the spectra of substances in the state of incandescence, but it is in all respects well adapted for the study of the spectra of solutions, in which a slight difference in the character of the solvent often makes far more difference in the position of the bands than any that could result from errors due to the employment of such a scale and notation. To hold the liquids under examination, I in most cases employ narrow, deep cells, usually one-eighth of an inch diameter, and half an inch deep, so mounted that they can be examined either in the line of the length or at the side; but occasionally I use rather wider, as much as two and a half inches long.

By using these narrow cells very much less material is required for successful examination, which is not only most important when very little is at command, but even in other cases often effects a considerable saving of time in filtration and evaporation.

I shall divide my subject into three principal heads, viz., 1. Various facts connected with wine; 2. Those relating to malt liquors; and—3. Such as illustrate the methods that may be employed to detect adulteration in various substances used as food or medicine.

1. *On the Colouring Matters of Wines.*

The pure colour of fresh dark grapes is best prepared by removing the skins, heating them in alcohol, evaporating the solution to dryness, re-dissolving it in a little water, filtering, and again evaporating to dryness in a small saucer, in which the colour may be kept as a stiff syrup for many months without material change. It belongs to the group of colours which I called group B in my paper in the *Proceedings of the Royal Society*—that is to say, sulphite of soda produces no immediate effect when added to a solution rendered alkaline by ammonia; but when added to one made acid with citric acid, it almost immediately removes the detached absorption in the green, so that the solution becomes very pale.

Since this colour of dark grapes is purple when dry and quite neutral, it may be called *Vitis purple*. I have not yet met with it in any other fruit, unless it be in that of the common crowberry (*Empetrum nigrum*). One of its peculiarities is that it easily passes into insoluble modifications. It belongs to my sub-group B al_o am_o, since it does not give any decided narrow absorption band in an alcoholic solution, when either neutral or with excess of ammonia. Such colours are amongst the most difficult to distinguish from one another, and I have not yet been able to discover any more satisfactory method than the following:—A slight excess of ammonia should be added to the alcoholic solution; made so dilute that the absorption in the orange part of the spectrum is distinct, but yet very far from black, and the position of the limit of the absorption towards the red end carefully measured and recorded, thus—$1\frac{1}{2}$ . . . .

The same limit should also be ascertained after con-

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* Communicated by the author, having been published in the *Quarterly Journal of Microscopical Science*, vol. ix., new series, p. 358.

† *Proceedings of the Royal Society*, 1867, vol. xv., p. 432.

‡ *Quarterly Journal of Microscopical Science*, January, 1869.

siderable excess of hydrochloric acid has been added to the solution, both in water and in alcohol; which solutions sometimes give the same, but sometimes materially different, spectra. These various limits of absorption vary with the depth of colour, but by taking care to have solutions which give equally strong absorptions, and comparing them side by side, it is often very easy to distinguish from one another very closely allied colours—for example, that of dark gooseberries from that of grapes, or that of fresh grapes from that of new dark wines. The difference between these latter is proved, not only by the spectra, but also by other facts.

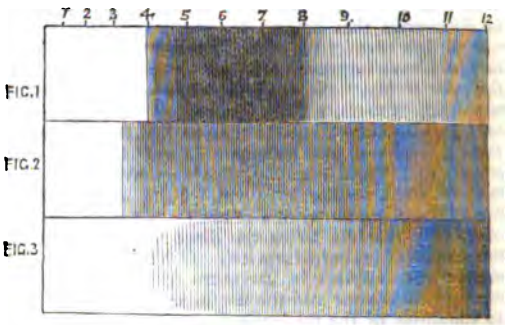
In my paper in the *Proceedings of the Royal Society* already cited (p. 443), I showed that when certain colouring matters are dissolved in water or alcohol, they give deep-coloured solutions, which rapidly fade to nearly colourless; but when these faded solutions are evaporated to dryness, the colour is completely restored to its original state, and is also made quite as dark as if it had never faded, by adding some strong acid; so that the fading is not due to decomposition, but to a molecular change rapidly taking place in dilute solutions. The colour of fresh grapes is an example of this; and by comparing with a standard which did not fade, the solution immediately after the colour was dissolved, and the same after less than an hour, when no further change occurred by keeping it longer, I found that the faded required fully five times the thickness to give the same intensity of absorption at the yellow end of the green. On the contrary, new dark wines evaporated to dryness do not fade at all in such a manner when re-dissolved in water.

This colour of new wines appears to be produced at a very early part of their formation. By dissolving the colour of the fresh grapes in the juice, adding a little yeast, and keeping the solution warm for a few days, the colour appeared to be changed into that found in new wines, and did not fade at all when re-dissolved in water. The colour kept as dry syrup for three years showed a similar change. I think it must be, therefore, due either to fermentation or to a slight oxidisation. I am much inclined to adopt the latter explanation, for if citric acid be added to an aqueous solution of the fresh colour, and then a small quantity of hypochlorite of soda, the colour is changed from pink to pink-red, the absorption is found to extend more towards the red end, and to be more uniform over the green and blue; in all which particulars it corresponds with the spectrum of new wine. No such change occurs when the wine is treated in the same manner, as though this alteration had already taken place. Both these colours belong to my group B; but when either is still further oxidised by means of rather more hypochlorite of soda, a sort of orange colour is produced, which seems to correspond with that of port wine kept for twenty years or more in the cask; and when still further changed, it becomes quite pale, like very old wines. The following table will show these facts more clearly:

Colour of dark grapes in citric acid and water	..	..	..	4	..	4½	—	—	18½	.. 11 — —
Ditto, after adding a little hypochlorite of soda	..	..	..	3½	..	3¾	—	—	—	—
New natural port wine	..	..	..	3¼	..	3¾	—	—	—	—
Ditto, after adding a little hypochlorate of soda	..	..	..	3¼	..	3¾	—	—	—	—
Colour of dark grapes with more hypochlorite of soda	..	..	..	5	..	6	—	—	10	—
New natural port wine with ditto	..	..	..	5	..	6	—	—	10	—
1834 port from the cask	..	..	..	5	..	6	—	—	10	—

Since this change in the spectrum depending on the state of oxidisation is of considerable interest as illustrating a general law, I here subjoin a woodcut,* in order to render more intelligible to those not accustomed to the use of the symbols employed in the above table. Fig. 1 shows the spectrum of the colour of dark grapes in its natural state, in citric acid and water. Fig. 2 is the spectrum of the oxidised modifications met with in new wines; and Fig. 3 that of the per-oxidised colour found in very old wines, or formed by the more complete artificial oxidisation of the other two.

This colour of very old wine belongs to my group C, and is not changed by adding sulphite of soda to an acid solution; whereas, as already mentioned, the characteristic colour of very new wine belongs to my group B, and if it could be obtained in a pure state, would probably become nearly colourless on the addition of the sulphite. This



difference between the colour of new and old wine has enabled me to contrive a method by means of which I can ascertain the approximate age of port wine kept in the cask. In these experiments I have been very much assisted by my friends, Mr. Joseph Prestwich, F.R.S., and Mr. Alexander Hay, of Sheffield, who have most kindly supplied me with the requisite samples.

(To be continued.)

* We are indebted to Messrs. Churchill and Sons for the use of this woodcut.

NOTE ON THE AMERICAN ECLIPSE.

Dr. Morton, Professor of Chemistry in the University of Pennsylvania, has kindly forwarded me photographs of the phenomena of totality. By combining in the stereoscope pairs of these, separated by intervals of about half a minute of time, the black globe of the moon appears projected far in front of the luminous prominences and the corona, which are, therefore, clearly seen to belong to the sun. Glass transparencies from negatives specially selected for this purpose, and appropriately mounted, would show these phenomena in a very striking manner.

William Crookes.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 2nd, 1869.

Dr. A. W. Williamson, F.R.S., &c., President, in the Chair.

The minutes of the previous meeting having been read and confirmed, the following certificates were read:—

For the first time—James Bell, Howell Hill, Ewell; G. R. Hislop, Gas Works, Paisley; William Ladd, Beak Street, Regent Street; Alfred Bird, Worcester Street, Birmingham; H. Seward, 15, Barnsbury Park, N.; Edwin Lepper, 11, Maiden Lane, Queen Street, Cheapside, E.C.

For the second time—Samuel Jefferson, Secretary to the Yorkshire Board of Education, Woodville Terrace, Woodhouse Lane, Leeds; Clements Higgins, Demonstrator of Chemistry, King's College, London; James John Bourey, Analytical Chemist, 10, Stepney Causeway, E.

For the third time—Matthew H. Cochrane, 108, Paul Terrace, Glasgow; Edward Smith, Practical and Pharma-

ceutical Chemist, Strand, Torquay; Thomas Walton, M.R.C.S., and L.S.A., Lecturer on Chemistry at the Hull and East Riding School of Medicine, Kingston-upon-Hull; G. Manley Hopwood, 22, Grosvenor Square, All Saints, Manchester; John Wiggin, Pharmaceutical and Analytical Chemist, Ipswich; Thomas Gibb, A.R.S.M., Engineer; George Harrison, Analytical Chemist, 26, Havelock Square, Sheffield; Sir Roderick Impey Murchison, Bart., F.R.S., Belgrave Square.

The last-named gentlemen were ballotted for and duly elected.

The first paper read was entitled "*Remarks on some Points in the Nomenclature of Salts*," by H. G. MADAN, F.C.S.

The author calls attention to the unsettled state of chemical nomenclature, and the difficulty of teaching the science while hardly two of our text-books adopt the same system of names, and while specimens of so many totally different systems are to be found in our periodicals. He then refers to the terminations to the electro-negative radicles, such as *-ide*, *-ite*, and *-ate*, and suggests that the accepted principle of indicating the amount of oxygen in the radicle by a change of a vowel in the name might be extended, so as to embrace such substances as chlorine and sulphur, which form, with oxygen, more than two radicles.

To distinguish the several members of each group of salts containing the same electro-negative or electro-positive radicle, the author prefers rather to add a prefix, such as *proto-*, *di-*, *tri-*, *per-*, &c., to the existing generic name for the salts of the electro-negative radicle with which it is associated than to change the termination of the name of the electro-positive radicle into *-ic* or *-ous*, as the prefix requires the least alteration in existing names, and is the more elastic system of the two.

Mr. Madan does not see the advantage of calling radicles by their Latin names, such as *argentic* nitrate or *ferrous* chloride, but if such a system is considered convenient, it should be carried out consistently, by using such terms as *kalic*, *natric*, *stilbic*, *hydrargic*, &c. The system of terminology proposed by Mr. Harcourt,* and adopted by Roscoe and Watts is, in the opinion of the author, more simple, permanent, and yet elastic, than any other.

Professor ATTFIELD thought the chief point about a name should be that it was unalterable. He objected to the use of vowels or of Latin or Greek numerals to express the name of a salt, as their views of the constitution of a substance sometimes changed, and when such was the case, it became necessary to alter the name.

The PRESIDENT said that Mr. Madan's proposal to revert to the use of such terms as *proto-*, *sesqui-*, and *per-* in order to designate the place of bodies which differ in their quantity of oxygen and chlorine in a series, implied that the series was known, whereas we are constantly altering our knowledge of such series. These words had been productive of considerable inconvenience and confusion, and he thought the terminations *-ous* and *-ic* as used by most writers, including Mr. Roscoe and Mr. Watts, were far more convenient. These terminations only denote a kind of difference in the constitution of certain substances: such a difference might be ascertained as a matter of fact. They might find other terms of each series, and a body which was first might become second, but if it contained less oxygen than another, it was correctly distinguished by the termination *-ous* instead of *-ic*. Mr. Madan seemed to think it necessary always to retain Latin words if they were used in certain cases. It was held by some persons that a variety of name was in many cases desirable amongst such compounds as Prussian blue, where iron figured in two capacities. He, the speaker, was not aware that those who advocated the view against which Mr. Madan contended had ever asserted that a Latin name, if used at all, ought universally to be employed; and if English names were insisted on, they would be led into eccentricities not less remarkable than those against which the author contends. Carbon and sulphur were Latin words which, if discarded in favour of the English words, would lead to words like charcoalic oxide and charcoalic acid, and brimstonic acid and brimstonous acid, a change which did not appear to him a very great improvement. It was exceedingly desirable that everybody should bring forward his own impression in the matter, because it was only by general consent that any important system could be established.

Mr. VERNON HARCOURT thought the difficulty attaching to the choice of names was inevitable in the present state of chemistry. Either a name must be unsystematic, and merely express one or two facts about the particular substance, *e.g.*, corrosive sublimate; or, if it was systematic, and expressed a relation between the particular substance and others, it must embody a theory not yet definitely established. With reference to English and Latin names, sulphur had for so long a time been used as an English word, that it was, in reality, no less so than brimstone. The latter, he supposed, was a German word, and sulphur was, originally, Latin, but it had now become as thoroughly English as any word in the language. With regard to using *ic* and *ous*, he thought that the terminations *proto* and *per* might equally be said to express facts; and it appeared to him that the objection raised by Mr. Madan, that the terminations *-ic* and *-ous* served only for two terms of a series, and that this mode of expression cannot be extended in cases where the series extends beyond two terms was a just one. At the same time, he thought that, where there were two parallel series of salts (such as mercurous and mercuric salts, ferrous and ferric salts), it was a great convenience to have these terms, and "ferrous salts" was, perhaps, a better expression than "iron proto-salts," which Mr. Madan recommended as a substitute.

Mr. MCLEOD remarked that there was a certain excuse for the use of Latin words, for, in almost all cases, they referred to the symbol.

Dr. ODLING said that Mr. Madan spoke of the convenience which occasionally attached to their being able to use such a word as "proto-salts," and to speak of proto-salts in general. It would be a real advantage if all proto-salts were conceived to have the same constitution; but, as the word proto-salts did not express the constitution any more than *-ic* and *-ous*, he could not admit that argument to have any weight in favour of the use of such words as *proto-* and *per-* rather than of *-ic* and *-ous*. He was rather inclined to agree with Mr. Harcourt's observations in defence of the English. Respecting such words as mono-chloride and bi-chloride of mercury, it was quite true that, if they used them, they meant that the one contained double the quantity of chlorine in the molecule to the other, and not merely double the ratio of the mercury and the chlorine.

The PRESIDENT hoped it would not be understood that he insisted on Latin names in preference to the English. When Latin names were more easily modified than English, by all means use them; but, when such was not the case, refuse them. It would not be worth while to employ English words instead of the Latin aluminium, chromium, &c.; and it should not be argued that, because they used English words in some cases, that therefore they must use them in all cases. The whole genius of the English language was at variance with that proposition. They wanted an intelligible principle to guide them, instead of the fixed names, which imply particular theories of the constitution of bodies. With regard to *-ic* and *-ous* only adapting themselves to one term of a series, he conceived that, as long as they had to do with the properties of bodies in chemistry, the difference between acid and basic bodies would be one of the chief things to refer to; and, if the business of names was to recall the chief properties of bodies, he thought it must be an advantage, in describing terms of a series, to use some name to distinguish those which were not acid from those which were.

* CHEMICAL NEWS, vol. xvi., p. 272.

Professor Voelcker said that, in one aspect, uniformity of nomenclature had great advantages; but he was not sure that one and the same chemical compound, having two, three, or four different names, was an unmitigated evil. In teaching chemistry, he would not object to a substance being called by the empirical name, if, by this means, certain properties were fixed upon the mind of the student, by which he became familiar with a certain definite substance. He might afterwards be told to call it by another name, and then by a third; and, when he was once familiar with the real nature of the substance, it was immaterial whether he knew it by one name or the other. By the same combination having different names, the teacher would be able to illustrate the different views entertained by chemists of the constitution of a substance.

The next paper was on "*Results of the Analysis of Sea Water Performed on board H.M.S. Porcupine, July*, 1869," by John Hunter, M.A., F.C.S.

The first part of this paper is devoted to abstracts of papers published on this subject by Darondeau, Aime, Bischof, Hayes, Morren, and Thorpe, given by the author to show that very little has been done in investigating the gases contained in the ocean at any great depth, and that the various experiments had not yielded identical results. To collect the water for his experiments, the author used a large brass tube, attached to the sounding-line. Two valves were placed in the tube, one at the upper end, the other below, but both opening upwards, so that, when descending, the water flowed freely through, but, when drawn up, the pressure of the external water closed the valves, and the sample of the last water which had entered the tube was secured. 800 c.c. were placed in a flask, and the gases determined by boiling, according to the method of Dr. Miller. The amount of organic matter was observed by Dr. Miller's process, and the specific gravity was also taken. Two series of experiments were made. In the first, the specific gravity of the bottom water was rather less than that of the surface; but, in the second series, they were identical. The carbonic acid was found to be in greatest quantity at the bottom; it then diminished a certain amount, and remained pretty constant until within about 100 fathoms of the surface, when it diminished still more. The amount of organic matter was about the same in bottom and surface water.

At the end, Mr. Hunter gives the results of his experiments in a tabulated form.

Mr. McLeod thought that, if the absolute quantity of carbonic anhydride or carbonic acid gas in 100 volumes of water had been given, the results would then have been more comparable, and the relation between sea water and ordinary spring water would be shown. The total quantity of gas in 100 volumes of sea water was much less than he would have expected, and less than is found in ordinary river waters. Thames water, he thought, contained 6 volumes in 100 of the three gases together; while the largest proportion of gas in sea water, according to Mr. Hunter, was only 2·8 in 100. It had been stated that sea water brought from a depth effervesced like soda-water; but that would seem to be almost an impossibility if the quantity of gas obtained was as low as 2·8. It was just possible that, in collecting the water, if there was any pressure in the tube, it would open the upper valve, and allow nearly all the gas to escape; but he (Mr. McLeod) was not in a position to suggest a better apparatus than the one described.

The President thought that, if it were soda-water below, they ought to cork it up before bringing it to the surface; but the results obtained by Mr. Hunter did not agree with the soda-water theory. He did not see that the gas should have any tendency to come off from the water, when there was so little of it there; but the quantities might not, perhaps, have been so great as reports made of experiments would lead one to expect.

The Society then adjourned to the 16th inst.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, December 6, 1869.

George Busk, Esq., F.R.S., in the Chair.

George Henderson Gibb, Esq., William Harbottle, Esq., John Henderson, Esq.; and Henry Musgrave Musgrave, Esq., were elected Members of the Royal Institution.

The following lecture arrangements for the ensuing season were announced:—

Professor Tyndall, LL.D., F.R.S.—Six lectures (adapted to a juvenile auditory), "On Light." On December 28th, 30th, 1869; January 1st, 4th, 6th, 8th, 1870.

Before Easter, 1870.

Professor Humphry, M.D., F.R.S.– Six lectures, "On the Architecture of the Human Body." On Tuesdays, January 18th to February 22nd.

Professor Odling, F.R.S.—Twelve lectures, "On the Chemistry of Vegetable Products." On Thursdays, January 20th to April 7th.

Robert Scott, Esq., M.A., Director of the Meteorological Office.—Four lectures, "On Meteorology." On Saturdays, January 22nd to February 12th.

Dr. Masters, F.L.S.—Two lectures, "On Plant Life as Contrasted with that of Animals." On Tuesdays, March 1st and 8th.

Professor Rolleston, M.D., F.R.S.—Four lectures, "Deductions from the Comparative Anatomy of the Nervous System." On Tuesdays, March 15th to April 5th.

Professor Max Müller, M.A., LL.D.—Four lectures, "An Introduction to the Science of Religion." On Saturdays, February 19th to March 12th.

Joseph Norman Lockyer, Esq., F.R.S.—Four lectures, "On the Sun." On Saturdays, March 19th to April 9th.

After Easter.

Professor Blackie.—Four lectures, "On the Principles of Moral and Political Philosophy." On Tuesdays, April 26th to May 17th.

Professor Tyndall, LL.D., F.R.S.—Seven Lectures, "On Physics." On Thursdays, April 28th to June 9th.

Professor Robert Grant, LL.D., F.R.S.—Seven lectures, "On Astronomy." On Saturdays, April 30th to June 11th.

Professor Seeley.—Three lectures, "On History." On Tuesdays, May 24th, 31st, and June 7th.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

November 8, 1869.

Joseph Baxendell, F.R.A.S., Vice-President of the Section, in the Chair.

The following note was read from Mr. Joseph Sidebotham:—

About fifteen years ago, I had a large cabinet, made of forty-five drawers, to contain shells and carpological specimens, the drawers being made of pencil-cedar. Very soon I found that the resinous vapour from the wood became deposited on some of the fruits and shells, making them appear as if they had been dipped in varnish. Chloroform appeared to be the only solvent, and the specimens were obliged to be washed with it. This became so bad that I had the whole of the drawers removed, and replaced with drawers of bay-wood. Some time afterwards, Mr. Carter advised me to have the cedar drawers sized and papered inside, and a new cabinet made to contain them. Accordingly, he made me one to contain thirty drawers. These drawers were exposed to the air for twelve months, and very well sized inside, and

papered; but the resinous vapour is still deposited on the objects in the drawers as before, and, so far, is a warning to every one never to use pencil-cedar for such a purpose. I should not, however, have thought this matter worthy of mention before the Section, had it not been for the very curious and capricious way in which some objects are coated with this resin, while others are left entirely free, and for which I am totally unable to account. In shells, the genera *Conus* and *Oliva* are never touched by it, nor are *Cyprea* or *Mitra*, whilst *Helix*, *Bulimus*, and *Pecten* are coated over. This is the case when there are specimens of these and other genera in the same drawer. As this deposit is on the genera I have named, and never on the others, it would seem to indicate that the texture of some shells would attract the vapour, and not others; but, in the case of birds' eggs, the very strange manner in which some species are picked out, as it were, and others left, is most remarkable. In the owl's eggs, for instance, the barn owl is always free, while the tawny owl is covered with the varnish, although side by side. The song thrush is never attacked, and the missel thrush always.

Trays exhibiting these peculiarities were passed round for inspection.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

The ordinary meeting of the Section was held on the evening of Monday, December 6th, Mr. William R. Hutton, Treasurer, presiding. Several candidates were proposed for admission, and several others were ballotted for.

The first paper read was entitled, "*Note on the Action of House Sewage on Lead Pipes.*" In introducing it, the author,

Mr. Edward C. C. Stanford, F.C.S., referred to the panic which had recently been shown by the voluminous correspondence in the local papers regarding the alleged impurity of the water used for domestic purposes, and stated that it had revived the old question of the action of the purer kinds of potable water on the lead of the pipes and cisterns. The panic, known locally under the name of "death in the cistern," had been completely allayed by the remarkable unanimity of the reports prepared by Dr. Anderson, Professor of Chemistry, and Dr. Wallace, Analytical Chemist, and backed by an eminent medical authority like Dr. W. T. Gairdner. Notwithstanding, however, that the amount of lead was small, a sufficient quantity had been found in almost all the analyses of the cistern water to show the desirability of avoiding all suspicion of lead contamination, by adopting a constant high-pressure service in iron pipes, and, where they are required, of using cisterns of iron or slate. The author remarked that much attention had, from time to time, been directed to the action of the purer kinds of potable water upon lead; but it was somewhat remarkable that an equally-important and much wider-spread evil of a similar character had escaped notice. He referred to the serious deterioration which lead pipes undergo which are connected with water-closets; and he brought this subject under the notice of the Section in order that some light might be thrown upon the cause of the said deterioration. Dr. Fergus, a Glasgow medical gentleman, had the credit of first directing attention to the subject by tracing a close connection between the deterioration of the soil-pipes and the existence of various forms of low febrile disease in the houses into which, from the degenerated condition of the pipes, sewer gases make their escape. By means of sketches and used-up specimens of soil-pipes, the author showed the nature of the action to which the pipes are subject from long use—the length of time varying from ten to sixteen years. Near the bend of the pipe leading from the closet the upper part becomes coated with a greyish white deposit that can be easily scraped off, and the interior of the pipe becomes pitted; while, exteriorly, the pipe is at first blistered at the parts corresponding to the internal "pits," and in course of time it becomes quite riddled with holes, and quite gnawed away as it were. Mr. Stanford had analysed samples of the deposit from several soil pipes, and had found from 86 to about 93 per cent of the deposit to consist of plumbic carbonate, the other ingredients being calcic carbonate, silica, insoluble plumbic oxide, water, and organic matter. After noticing the chemical compounds which, in solution in water, act readily upon lead, the author said that the deterioration referred to was not due to those substances, inasmuch as they were found in the excreta, whereas the injury to the pipes took place in the air-space of the bend, and not in the water-space in which the "trapping" was effected. It has been remarked by plumbers, that a piece of lime, or newly-mixed mortar, in contact with a pipe, rapidly eats through it, probably by the lime combining with the carbonic acid of the outside film, and so cleaning the lead that the action of the air repeats the process. In the opinion of the author, alkalies would probably have the same effect as lime, and so clean the lead that a moist atmosphere would act on it. The effect of pure water on lead is first to dissolve it as oxide, and then this is precipitated as oxycarbonate, which is very insoluble, pure water only dissolving 1-60th of a grain per gallon. Water free from air does not act on lead; and the author therefore thought the action referred to might be due to the air carried down by the rush of water while the closet was acting, and by the carbonic acid, or by the ammonia of the gases of decomposition acting as a cleaner, the interior of the pipe being always in a moist condition. Mr. Stanford concluded by recommending the discontinuance of lead soil pipes, and the substitution of earthenware syphons and flanged cast-iron pipes.

Dr. Fergus, in opening the discussion, recommended that soil pipes should be ventilated, or that they should be used as the rain-water pipes. He gave some instances, in his professional experience, of the connection between such diseases as gastric fever, diphtheria, &c., and bad soil pipes; and he strongly urged the periodical investigation of such pipes.

Mr. Sutherland suggested that the action might be due to sulphuretted hydrogen or acetic acid; but Mr. Stanford said that plumbic sulphide had never been found in his analyses.

Mr. Anderson believed that nitric acid, resulting from the oxidation of ammonia, might have some influence in producing the injurious effects on the pipes. This view was supported by Mr. Hutton and Mr. Tatlock. The first-mentioned gentleman referred to experience extending over sixteen years, and said that Loch Katrine water is very peculiar, in having an abundance of dissolved oxygen and very little carbonic acid, and that such water rapidly acts on lead, producing oxycarbonate, which is readily soluble in fresh water from the same source.

Mr. Stanford replied that he had never met with nitrates in the course of his experiments.

A vote of thanks was awarded to Mr. Stanford.

A paper was then read by Mr. R. T. Tatlock, F.C.S., "*On the Estimation of Iodine and Bromine, with special reference to the Analysis of Kelp.*" We are compelled to hold over this paper for a week.

ROYAL IRISH ACADEMY.

The general meeting of this society was held on Tuesday, November 30th, Right Hon. the Earl of Dunraven in the chair.

The first business was the election of a president, in room of Lord Talbot de Malahide.

Dr. Loyd, Provost of Trinity College, moved that the Rev. John Jellett, F.T.C.D., be elected president. He said that Professor Jellett's high scientific claims were thoroughly known by the members of the Academy, before which body his investigations had been brought. In the higher abstract sciences, Professor Jellett was second to none in this part of the empire, with the exception of one, who had retired, and he combined scientific attainments which were not often found in the same man. Dr. Stokes, in the absence of Dr. Russell, President of Maynooth, seconded the motion. Professor Jellett was duly elected by ballot. This election gives general satisfaction, as it has been felt for some time past that the scientific element in the Academy "has not," as the Earl of Dunraven expressed it, "taken the position that was its right."

Sir WILLIAM WILDE then read a paper upon "*A Collection of Gold, Bronze, and Iron Antiquities Found in Excavations made for the Supplying of Gravel to the City.*" They were supposed to be of Scandinavian origin.

Dr. APJOHN then read a paper "*On the Proximate Analysis of Saccharine Substances.*" In this method, the author makes use of the optical and chemical processes, and thus quantitatively determines the amount of cane sugar, inverted sugar, and grape sugar in a given sample. An extended report of this paper will shortly be given in the CHEMICAL NEWS.

NOTICES OF BOOKS.

The Students' Chemistry; being the Seventh Edition of Household Chemistry, or the Science of Home Life. By ALBERT J. BERNAYS, Ph.D., F.C.S., Professor of Chemistry and of Practical Chemistry at St. Thomas's Hospital Medical and Surgical College, &c., &c. 1869. W. H. Allen and Co.

THE well-known and popular work of Dr. Bernays has, in this new edition, been so completely altered and recast that it is, in point of fact, a new book. The experiment of altering the form of a work which has met with such marked favour from the public is a bold one, but we have no hesitation in predicting that, in the present instance, it will be entirely successful.

The book, in its present form, has no longer the popular and readable character that it formerly possessed; but, on the other hand, it is now, what it never was before, a systematic and complete manual for students. It is very lucid in style and practical in matter. It contains a vast mass of fact simply and accurately stated, and bound together by just as much theory as is necessary for the understanding and remembering of it. The notes with which each chapter is headed are very clear and full, and will assist the labours of the student most materially. The author promises to devote a second volume to organic chemistry and to the theories of the science, and confines the present one to inorganic chemistry.

If this second volume is as good as the first, it will be a very useful book.

CORRESPONDENCE.

COAL DYES IN 1818.

To the Editor of the Chemical News.

SIR,—I read in *Blackwood's Magazine*, for June 1818, p. 339, the following paragraph, which may, perhaps, be interesting to many of your readers:—

"*New Extracts from Coal.*—Dr. Jassmeyer, Professor of Chemistry in Vienna, has discovered the means of extracting from coals two hitherto unknown acids, a resin, a resinous gum, and other elements, which he has employed with surprising success to the purposes of dyeing wool, silk, hair, and linen, and has produced from them red, black, yellow, and various shades of brown and grey. Count von Chorinsky, President of the Aulic Chamber, and many other enlightened judges of these matters were present at these experiments, and testified their entire approbation of this useful discovery."

Can any of our brother chemists inform us whether these products are known at the present day, and under what names?—I am, &c.

T. L. PHIPSON, Ph.D., F.C.S.,
Member of the Chemical Society of Paris.

Analytical Laboratory, Putney, S.W.
November 29, 1869.

MISCELLANEOUS.

University of London.—*Second B.Sc. Examination (Examinations for Honours, B.A. and B.Sc. conjointly).*—Mathematics and Natural Philosophy: First Class. Richard Pendlebury, B.A. (scholarship), St. John's College, Cambridge. Logic and Moral Philosophy: First Class. Matthew Robertson, B.A., New College; Walter William Rouse Ball, B.A., University College. Third Class. Arthur Clarke, B.A., Wesley College, Sheffield; Alfred Milnes, B.A., Manchester New College; James Greaves, B.A., private study; Frederick de Sola Mendes, B.A., University College; and Stephen Peter Hayes, B.A., Stonyhurst College, and Henry Keatley Moore, B.A., private study (equal). (*B.Sc. only.*)—Chemistry: First Class. Alexander Muirhead, University College. Second Class. Charles Thomas Whitmell, St. John's and Trinity Colleges, Cambridge. Geology and Palæontology: First Class. Charles Thomas Whitmell, St. John's and Trinity Colleges, Cambridge; Frederick Antony Potter, Royal School of Mines. Zoology: First Class. Phineas Simon Abraham, Trinity College and Royal College of Science, Dublin. Second Class. William Henry Johnson, University College.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, November 29, 1869.

This number contains the following memoirs and papers relating to chemistry and allied sciences:—

Construction of an Optical Plane.—M. Foucault.—It appears that M. A. Martin has found, among the papers left by the deceased author, a short note on the proper means to realise the construction of an optical plane—that is to say, a plane surface so perfect that the reflected ray of light in no respect differs from the incident ray.

Improving Wine by Electricity.—M. Scoutetten.—The author states that the accidental striking of lightning on the house of a vineyard proprietor caused the rupture of several large hogsheads containing wine, which found its way into a cavity existing in the cellar of the house. The owner imagined his wine lost and spoiled, but found, to his astonishment, that the wine, instead of having been deteriorated, had become better than it was before. This accidental occurrence having come to the knowledge of General Marey-Mouge, caused the author of this paper to be consulted, and a series of experiments were instituted with various kinds of wine, of inferior as well

as medium quality, the result being that a galvanic current, applied to the liquid in the casks, both electrodes consisting of platinum plates, eminently improves even very inferior kinds.

Rendering Rivers Wholesome.—M. Gérardin.—According to this author, the fouling of rivers and water-courses is greatly due to the starch manufactories situate along the same, in consequence of the discharge of water containing up to 7 and 8 per cent of albuminous matter, which soon enters into decay, giving rise to the formation of myriads of lower forms of animal life, which withdraw from the water its dissolved oxygen, and hence cause the destruction of higher organised plants and animals.

Researches on Solar Radiation.—MM. Desains and Branly.—This paper, and the following—

Expansion of Gases—M. Moustier—Are not well suited for useful abstraction.

Molecular Action in Atmospheres of Chlorine, Bromine, and Iodine.—M. Valson.—This memoir contains the results of a series of experiments relating to the capillary action of chlorides, bromides, and iodides in aqueous solution and immersed in gas or vapour of the haloids above mentioned. The results are exhibited in tabulated forms.

New Method for the Preparation of Anhydrous Nitric Acid.—MM. Odet and Vignon.—The authors refer first, at some length, to the now well-known, yet difficult and highly delicate, method of obtaining anhydrous nitric acid, discovered by M. H. St. Claire-Deville. The authors obtain this compound by causing chloride of azotyl to act upon perfectly dry nitrate of silver at from 60° to 70°. Chloride of azotyl is prepared by the action of oxychloride of phosphorus upon nitrate of lead, or, better yet, nitrate of silver. The chloride of azotyl is a slightly yellow-coloured liquid, boiling at 5°, and not frozen at −31°; in contact with water, this substance is decomposed into nitric and hydrochloric acids. The vapour of this fluid is applied for the decomposition of dry nitrate of silver, in a simple apparatus consisting of U-shaped tubes soldered together by means of suitably-bent glass tubes. The chloride of azotyl is prepared simultaneously with the anhydrous nitric acid, which is collected in a tube placed in freezing mixture at −25°.

Preparation of Hydrate of Chloral.—M. Roussin.—The mode of preparation here described is precisely the same as that already well-known, and lately quoted by us from a German paper. Pure hydrate of chloral is a snow-white crystalline substance, not exhibiting any smell at the ordinary temperature of the air; it volatilises slowly, without absorbing much moisture, unless it be placed in a very damp place; fuses at 56°; boils at 145°; is completely soluble in a small quantity of water, and also soluble in alcohol, ether, chloroform, sulphide of carbon, benzine, and fatty substances. Its aqueous solution ought to be neutral to test paper, and ought not to become turbid by a solution of nitrate of silver. When, to this aqueous solution of hydrate of chloral, a few drops of a solution of caustic potassa are added, there is formed chloroform, easily recognised by its peculiar smell.

So-called Inverted Sugar.—M. Dubrunfaut.—There is appended to this paper a short foot-note, from which it appears that there belong to it two papers not printed yet, by M. Maumené, without which this subject is not complete.

Radiation from the Moon.—M. Marié-Davy.—A third memoir on the much-vexed question about the heat given off by our satellite. This memoir is a purely mathematico-physical essay.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 16, 1869.

The president, Dr. A. W. Hofmann, opened the ordinary meeting, from the *procès verbal* of which we learn the following items:—Among the ordinary members elected, we find the name of Prof. Chandler, of New York. Prof. Baumhauer, of Haarlem, promises to send to the Society a regular account of all that is done on chemical territory in the Netherlands. The president exhibits several samples of partly crystallised tin, received from M. Fritsche, of St. Petersburg; this crystallisation is the effect of a continued exposure for three hours of the metal to a temperature below the freezing point of mercury. When the metal is exposed for any length of time to this low temperature, it falls completely to a greyish coloured powder; when this powder is heated to 100°, it becomes whitish-grey coloured. The president exhibits several photograms representing partially-crystallised organ-pipes, which had been inspected and photographed by the late Prof. Erdmann. We may mention here that this crystallisation of the tin whereof organ-pipes are made is by no means an uncommon phenomenon, and one not solely due to cold alone, but, in a great measure, to the vibration these pipes are subject to. The president exhibits a number of samples of wool, dyed green with the so-called iodine green, by M. T. Peters, of Chemnitz, and hands round to the members circulars issued by that dyer, and printed in German, French, and English, on the best method of applying this dye.

Preparation of Hydrate of Chloral.—MM. Müller and Paul.—The chief part of this operation consists in passing a current of dry and pure chlorine gas into pure and absolute alcohol, until the contents of the flask are, after about 70 hours, converted into a white and crystalline mass; when this operation is properly conducted, a large quantity of hydrate of chloral is obtained. The authors state that they had found by experiment that the hydrate of chloral is readily sublimed, and may be thus obtained as a dry, snow-white, neutral crystalline powder.

Relation of Mercury-Phenyl to the Aromatic Series.—MM. Dreher and Otto.—Mercury-phenyl is formed by the action of $HgNa_2$ upon C_6H_5Br—

$$2(C_6H_5Br)+HgNa_2 = \left\{\begin{matrix}C_6H_5\\C_6H_5\end{matrix}\right\}Hg+2NaBr.$$

The addition of a small quantity of acetic ether greatly promotes the reaction. ClH, IH, and BrH decompose—

$$\left\{\begin{matrix}C_6H_5\\C_6H_5\end{matrix}\right\}Hg,$$

according to the following equation:—

$$\left\{\begin{matrix}C_6H_5\\C_6H_5\end{matrix}\right\}Hg+2HCl=HgCl_2+2C_6H_6.$$

By the action of chlorine, bromine, and iodine, it is not easy to obtain from mercury-phenyl the respective chlorinated, bromated, and iodated compounds; the reactions and decompositions which take place are represented by the following formulæ:—

$$\left\{\begin{matrix}C_6H_5\\C_6H_5\end{matrix}\right\}Hg+2Cl=\left\{\begin{matrix}C_6H_5\\Cl\end{matrix}\right\}Hg+C_6H_5Cl;$$

when chlorine was made to act upon—

$$\left\{\begin{matrix}C_6H_5\\Cl\end{matrix}\right\}Hg+2Cl=C_6H_5Cl+HgCl_2.$$

We refrain from further abstraction of this lengthy paper, which is chiefly composed of a mass of formulæ.

Phosgene.—MM. Emmerling and Lengyel.—This paper is divided into three sections:—(1) *Conversion of carboxysulphide into phosgene.*—Chlorine does not act upon carboxysulphide at the ordinary temperature; but when a dry mixture of both gases is made to pass through a red-hot porcelain tube filled with fragments of broken porcelain, a gaseous mixture of CO, $COCl_2$, SCl_2, and unchanged Cl and COS. In order to recognise the phosgene, and estimate its quantity, the gaseous mixture just alluded to was passed through tubes filled with black sulphuret of antimony, this serving the purpose of separating the phosgene from various admixtures. For the purpose of analysis, the gas was collected in tubes, inside of which a small glass globe was placed, filled with a solution of caustic potassa. After the tubes had been filled with the gas, and sealed, this glass globe was broken (its walls being very thin), by shaking the tube in the fluid contents. After a time, the relative proportions of Cl and S were determined, and in other portions of the gas the CO was separately estimated. (2) *Preparation of phosgene from chloroform.*—This fluid is split up by the action of sulphuric acid and bichromate of potassa, yielding phosgene—

$$2CHCl_3+3O=2COCl_2+H_2O+Cl_2.$$

Forty parts of strong SO_3, five parts of bichromate, and two parts of chloroform yield, when heated on a water-bath, a phosgene free from oxygen. (3) *Fluid phosgene.*—This was obtained by passing the gas through an U-shaped tube placed in ice. The fluid gas is very volatile, and specifically heavier than water, by which liquid it is decomposed, evolving CO_2.

Under the title of "Correspondence," we meet with a first instalment of a report about the meeting at Inspruck, held in September last. Leaving the excellent and thoroughly German and enthusiastic general account of this meeting, we learn that the chemical section was presided over by Prof. Hlasiwetz, of Vienna, and that eighty-six members regularly attended, while the audience was even rather too large for the large chemistry lecture-room of the University wherein this section met. The following subjects were treated:—

Origin (Entstehung) of Iodoform, and the Applicability of the Formation of Iodoform for Analytical Purposes.—M. Lieben.—Iodoform is, according to this author, the most delicate test for alcohol, provided such substances be absent as might happen to exhibit the same reaction. In ether, even when distilled over sodium, alcohol can be detected by iodoform; and there is no doubt, the author says, that alcohol is formed in all ether which contains or can absorb water. Only those substances which contain CH_3 are capable of forming iodoform.

Modifications of Lactic Acid.—Dr. Wislicenus.—According to the author, there exist three modifications of oxypropionic acid. The lactic acid of fermentation, ethyliden lactic acid, differs from the ethylen lactic acid, and is easily obtained from β iod-propionic acid. The lactic acid of muscles differs from the two alluded to, but is not a chemical individual, since it is made up of ethylen lactic acid and a peculiar modification of ethyliden lactic acid.

Phenicin.—Prof. Bolley.—The substance known as phenicin, a brown colouring dye, also known as phenyl brown, is made by adding phenol to a mixture of nitric and sulphuric acids, and by pouring this mixture afterwards into a large bulk of water, when the phenicin is obtained as an amorphous powder. The manufacture of this preparation has given rise already frequently to serious explosions. The author found that the commercial article, as well as the pure article (phenicin), contains binitrophenol, a brown amorphous substance, which is neither a nitro nor a sulpho compound, and produced, it appears, by the action of sulphuric acid upon binitrophenol.

Proteine Compounds.—Dr. Schwarzbach.—The author states that the differences found by many experimenters, in the reaction of the potassio-platinum cyanide with the proteine compounds, is due to the fact that, instead of the Gmelin salt, that of Quadrat has been applied.

Preparation of Iodine Substitution-Products.—Prof. Hlasiwetz.—To the substance which is to be iodised, peroxide of mercury

is added, and the requisite quantity of iodine is added afterwards. The researches on this subject are not quite complete.

At the meeting of the Russian Chemical Society, held on the 2nd of October (O.S.) last, the following communications were made (communicated by M. von Richter, St. Petersburg):—

Benzimide.—M. Zinin.—The so-called benzimide of Laurent, $C_{28}H_{18}N_2O_2$, which is formed by the action of hydrocyanic acid upon essential oil of bitter almonds, is converted, when heated to from 160° to 180°, into an amide—

$$C_{28}H_{18}O_2N_2 + H_2O = C_7H_6O + C_{16}H_{14}O_2N_2,$$

and into a nitrogenous compound, which is the imide of formobenzilic acid.

Bromocamphoric Acid.—M. Wreden.—When dry camphoric acid is heated with bromine to 120°, monobromocamphoric acid anhydride, $C_{10}H_{13}BrO_3$, is obtained. This substance is nearly entirely insoluble in water, alcohol, and ether, at ordinary temperature; it sublimes at about 60°, but is also partly decomposed at that temperature. When this anhydride is boiled with water, a new acid, $C_{10}H_{14}O_4$, is obtained; this acid is readily soluble in water, alcohol, and ether, crystallises from its aqueous solution, sublimes at 110°, and fuses at 201°. The lead and copper salts of this acid are soluble in water; the soda-salt is a very deliquescent substance.

Valerian Aldehyde and Œnanth Aldehyde.—M. Borodin.—When the two substances just named are heated to 240° in sealed tubes, several products of condensation can be directly obtained; the reaction goes on steadily, water is formed, no resinification takes place, and, on opening the tube, no pressure is experienced. The valerian aldehyde yields, when submitted to fractional distillation, two oily fluids, one of which boils at from 195° to 200°, the other at from 180° to 200°. The analysis of these substances proved the first to be the condensation product of two molecules of aldehyde, from which one molecule of water was expelled; the other substance is a polymer of the last-named.

Atomic Weights.—M. Mendelejeff.—This paper contains a new plan of grouping the elements, according to the numerical value of their atomic weights, in the following manner:—Li, 7; Be, 9·4; B, 11; C, 12; N, 14; O, 16; Fe, 19; Na, 23; Mg, 24; Al, 27·4; Si, 28, and so on; but there is a considerable hiatus between Cl, 35, and the next, Ag, 108. The author points out that this grouping of the elements expresses the law according to which the elements can combine with oxygen.

On Xylidine.—M. Tawildarow.—The author prepared xylidine from isoxylol, which was obtained from coal-tar xylol by boiling that substance with dilute nitric acid. The nitroisoxylol thus obtained was reduced by means of tin and hydrochloric acid, and the xylidine purified by means of caustic potassa; the substance thus obtained is a colourless fluid, boiling at 216°; sp. gr. at 18°, 0·985. The oxalate of xylidine crystallises, and is somewhat soluble in water. When xylidine is submitted to distillation, a solid matter is left, which, on being heated to about 240°, yields a substance soluble in alcohol, crystalline, and fusing at 89°; this is a basic substance containing chlorine; its hydrochloric acid compound has the following composition:—$N(C_8H_8Cl)_3.HCl$. 100 parts of xylidine yielded about from two to three parts of this material.

Polytechnisches Journal von Dingler, second number for October, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Blast Furnaces constructed for the Continuous Flowing Off of Slag.—M. Lürmann.—This paper contains the description of an improved blast furnace for ironworks. From a foot-note added to the paper, we learn that the Old Park Iron Company, Shropshire, have adopted the improvements invented by this author, and are highly satisfied with the results.

Chemistry of the Blast Furnace.—M. Schinz.

Manufacture of Steel for the Use of Rifle Guns and Heavy Ordnance at the Works of M. Cockerill, at Séraing.—M. Greiner.—The author states that, at Séraing (near Liège, Belgium), the following three points are rigorously attended to as regards the manufacture of steel for the purpose indicated:—Purity of product; homogeneity thereof; and the exercise of proper control to ensure these requisites. It appears that this branch of manufacture is attended to in a thoroughly scientific manner, the use of the spectroscope, and of chemical analysis and assays, being matters of daily application. The test for carbon is executed in the following manner:—Of two samples of the same kind of steel, 0·2 grm. are placed in beaker-glasses of fully 20 c.c. capacity, and treated with nitric acid of 1·2 sp. gr.; the glasses are kept for four hours on a water-bath, and heated to 80°. The solutions assume a brownish yellow colour, which is compared with the colour which two other solutions of the same quantity of steel, containing a known quantity of carbon (0·61 and 0·63 per cent), assume after the four solutions have been all diluted with the same quantity of pure water. Suppose the solutions of steel containing known quantities of carbon to be respectively diluted to 252 and 260 c.c., and the solutions of the steel under examination to 142 and 144 c.c., the following calculation will give the required result:—

$$\frac{142 \times 61}{252} = 34{\cdot}33; \quad \frac{144 \times 63}{260} = 34{\cdot}90;$$

therefore the average = 34·615 = 0·346 per cent.

Boiler Incrustation, from Lillschacht, near Pribram.—Dr. Mrazek.—The author obtained for analysis and investigation a quantity of a very white, compact, micro-crystalline substance, which was stated to be the incrustation found in a steam boiler fed with water pumped from a mine. On being analysed, the stone was found to consist, in 100 parts, of:—Lime, 33·60; sulphuric acid, 47·41; magnesia, 12·26; water, 5·52; impurities, 0·79. This result leads to the formula $2(CaO,SO_3)+(MgO,HO)$, constituting, in fact, a mixture of anhydrite and brucite. The analysis of the water proved it to contain, in 10,000 parts—Sulphuric acid, 5·51; lime, 3·40; magnesia, 0·23; with traces only of chloride of sodium and soluble organic matter. The author also obtained a quantity of mud taken from the same boiler; this mud was found to consist, in 100 parts, of—Anhydrite, 14·24; hydrated magnesia, 2·27; lime, 16·49; carbonic acid, 12·06; clay, particles of quartz, oxides of metals, and metallic sulphides, 30·26; particles of wood and water (the former predominating), 23·78. The author states in this paper that if, in the case of boiler explosions, it is possible to obtain some of the incrustation of the exploded boiler, the analysis of that incrustation may lead to the detection of the cause of the explosion; if due to the want of water, and the boiler-plates becoming red-hot, the exact estimation of the water chemically combined with the incrustation is sufficient, since, if the boiler had been red-hot, the whole of the water of combination will have been expelled.

Apparatus for the Safe Keeping and Transport of Petroleum, Benzol, &c.—Dr. Tech.

Application of Iridium for Staining Glass and China.—M. Frick.—It appears that pure oxide of iridium yields, upon glass and china, a black-coloured stain of so intense and deep a tone of shade that the other substances in use for that purpose are, compared with this colour, of a brownish hue. The pure oxide of iridium is obtained, especially as a bye-product, in the purification of American platinum ores, and may be obtained from M. Röszler, at Frankfort-on-the-Maine.

Moniteur Scientifique, November 15, 1869.

Artificial Alizarine.—M. Bolley.—There are at present already three artificial products which come into competition with madder and its various preparations, viz.:—(1) It appears that MM. Græbe and Liebermann have stated, at the congress of German *savants* lately held at Insprück, that they can dispense with the use of acetic acid and bromine, and will be enabled shortly to bring into the trade a superior product, made by a method different from that described in their patent, and that this new product will be manufactured at Manheim by a celebrated firm of aniline colour makers. (2) Artificial purpurine and alizarine, made by MM. Broenner and Gutzkow, according to their patent, by the action of protonitrate of mercury upon anthrachinon; this process is carried on at Frankfort-on-the-Maine. (3) Artificial alizarine (alizapurine, according to M. Alfraise), prepared, by a process as yet kept secret, by MM. Meister and Lucius, at Hoechst, near the same city just named. The author of this paper just named states that he received from M. Riese, the head chemist to the firm just alluded to, at Hoechst, a quantity of 500 grms. of the paste (artificial alizarine) in question, with the request to assay it and report thereon. This substance exhibits a greenish brown-coloured, rather fluid paste, containing about 6 per cent of dry solid matter; when this dry substance is cautiously submitted to an elevated temperature, a brick-red coloured sublimate is obtained in needle-shaped crystals, a bulky carbonaceous residue is left, and, on igniting this, the ash is found to contain a large proportion of oxide of iron. The sublimate dissolves in caustic soda, exhibiting a very deep blue-violet colour; this solution yields, by the addition of chloride of barium, a bluish violet-coloured precipitate, which resembles, in a high degree, the precipitate obtained under similar conditions from the alizarine of madder. The ammoniacal solution of the sublimate, and the precipitate formed therein by the baryta-salt, also, resemble the reactions obtained from native alizarine from madder under the same conditions. The sublimate referred to yields, on being boiled with a solution of alum, a partial solution in alum, but the dissolved material precipitates on cooling, and the fluid then exhibits only a rose-red colouration; it would accordingly appear that the sublimate consists mainly of alizarine, mixed with very little purpurine. The results of elementary organic analysis of this substance are quoted as follows, three analyses having been made, and the carbon and hydrogen only put down percentically:—C, 69·23; H, 3·38; C, 66·04; H, 3·28; C, 66·46; H, 3·39. The composition of purpurine, according to M. Schutzenberger, $C_{20}H_{12}O_7$, requires percentically—C, 65·93; H, 3·29. Alizarine dried at 100° is, according to Dr. Schunck, percentically—C, 69·13; H, 4·03; and, according to MM. Bolley and Rose—C, 69·54; H, 3·75. The author infers, from these facts, that the sublimate holds a composition intermediate between alizarine and purpurine; that the first portions of the sublimate above referred to contain more, or, rather, approach more to, alizarine, and the latter portions more to purpurine. On comparing the tinctorial properties of this sublimate with those of alizarine obtained from madder, the following was observed:—(1) In the dry state, the artificial alizarine in question is less suitable as a dye than when it is in paste; (2) its tinctorial power, when dry, is at least equal to one-and-a-half times the same weight of raw (green) alizarine from madder, as prepared by M. Kopp's process; (3) the artificial alizarine dyes mordanted cloth rapidly, but soils the white grounds more than green alizarine; (4) the red is very brilliant and pure after cleansing (*avivage*); (5) the violet assumes, after cleansing, a greyish hue, and the puce and black are excellent. All these colours are fast, and in no way inferior to those obtained from madder. According to the author, the experiments instituted by MM. Alfraise and C. Kœchlin, with the view to prove that the preparation alluded to, and produced by MM. Meister and Co., is neither alizarine nor purpurine—are not made with sufficient care, and with

a too impure material (the paste only) to deserve the required confidence. As regards the tinctorial power of the paste, also, this appears to have been overrated by M. C. Kœchlin.

Dyeing with so-called Iodine-Green Paste on Wool.—M. Kalle.—This author, wholesale manufacturer of artificial dyes at Biebrich (Nassau, Prussia), states that, having read the communication on the process described by M. Peters in the number of the 1st of November last of this periodical, he feels obliged to point out the following defects in that communication:—(1) When the workman does not happen to use great skill and precaution, the green does not completely dissolve in acidulated water; hence there is a loss of colouring matter. (2) When the colouring matter does not dissolve completely, filtration has to be resorted to, which it is best to avoid. The author next gives the following directions, referring, however, to the use of a pure paste only:—The paste is mixed up with one or two parts of cold water (the quantity of water depends upon the state of concentration of the paste; if the latter happens to be very fluid, or, what amounts to the same, poor in colouring matter, the addition of water is unnecessary), from six to eight parts of alcohol are added, and the mixture well stirred up. *Impregnation tincture.*—The dye-bath ought to contain, for 1 kilo. of green in pasty state (price 50 francs, £2), 1 kilo. of silicate of soda of 30 per cent strength, and is brought to the boiling point. When this has been reached, the alcoholic solution of the green above alluded to is poured into the bath, and the wool thoroughly worked through it, without more heating, until the desired shade has been obtained; the wool is next drained, wrung out, and washed in cold water, and then only brought into the developing bath composed as described by M. Peters. The author adds that the developing bath becomes gradually saturated with dye-stuff, and then unfit for use for clear shades of colour; when this point is reached, the liquid is filtered, neutralised with ammonia, a fresh quantity of silicate of soda is added, and the liquid so obtained used as a dye-bath.

Preparation of Victoria Yellow (Binitronaphthol).—MM. Darmstädter and Wichelhaus.—One part of naphthaline is mixed with two parts of concentrated sulphuric acid, and heated on a water-bath until the solution is complete; the sulpho-naphthalic acid so obtained is saturated with soda, and the solution is evaporated to dryness. The sulphonaphthalate of soda is next fused with caustic soda, and the mass resulting from this operation is dissolved in water and supersaturated with HCl, whereby naphthol, or hydrate of naphthyle, is separated. This substance is next boiled with a mixture of sulphuric and nitric acids, yielding binitronaphthol, the yellow colouring matter; this substance is chemically different from, but, after all, isomeric with, the so-called Martius yellow, or binitronaphthylic acid. The formula, $C_{20}H_6.N_2O_{10}.O_2$, answers for both equally well; industrially speaking, both substances approach each other to such a degree that they may be considered identical; both are best used in the state of ammoniacal salt, this being the most readily soluble salt for each. These materials are employed at Paris for the adulteration of gamboge, and very largely used for the colouration of artificial flowers, leather gloves, &c.

Manufacture of Carbonic Acid on the Large Scale.—M. Dietz.—After reviewing several processes in use for this purpose, the author describes, at great length, a process in actual use at Kama, near Tschistopol, Russia. The gist of the description is that the gas given off by a lime-kiln heated with wood is used as a source of carbonic acid for converting carbonate of soda into bicarbonate. During twenty-four hours, 900 cubic metres of carbonic acid gas are consumed, and the combustion of the wood used for heating the kiln is so regulated as to yield a portion of that gas along with that obtained from the limestone; wood, however, in that locality, is almost a waste material, being extremely abundantly found.

Grotto of the Dead.—We notice the title of this paper, which contains a very interesting description of the Baumo das Morts, near Durfort, Departement Du Gard, France. For the study of the earliest age of man's appearance on the globe, this is a valuable contribution.

Journal für Gasbeleuchtung, Nos. 9 and 10, 1869.

These numbers contain the following original papers relating to chemistry and allied sciences:—

What is Good Gas?—Dr. Schilling.—In a lengthy and exhaustive paper, the author reviews this question on all sides, and comes to the following conclusions. A good and suitable gas for artificial illumination ought to possess the following qualities:—(1) The gas ought to possess a normal illuminating power. The exact determination of the value of the normal illuminating power can only be obtained when the gas made from various qualities of coal, and manufactured according to rational principles, is compared, under exactly identical conditions, with the normal standard candle. Any gas which, by a combustion of 5 cubic feet per hour, exhibits a light equal to fifteen spermaceti candles, may be considered a gas of good illuminating power. (2) The gas should be absolutely free from sulphuretted hydrogen. (3) The pressure of the gas at the works and in the leading mains should, as a minimum, amount to from 0·8 to 1·0 of the water-pressure guage.

Researches on the Coals from Saarbrück.—M. Gasch.—A most valuable addition to the chemistry and technology of coals, containing the results of elementary organic analysis, the quantity and quality of gas and coke yielded by each kind of coal, the transportability of the coal (*i.e.*, the resistance against breakage and falling into smalls and dust), carefully determined. The value of coal and coke as fuel, and the exact determination of the illuminating power and durability of the gas, when manufactured on the large scale, according to the best method, including pyrometrical measurement of heat applied to the retorts.

Gas Meter Testing Regulations for the North German Confederation.

Hydrogen and Carbonic Oxide Gas.—M. Schinz.—The author proposes the use of a mixture of equal quantities, by bulk, of these gases, instead of hydrogen only, for illuminating purposes, by means of incandescent platinum. Experiments made prove that the illuminating power of this mixture is, for equal consumption, equal to 1·242, coal gas of good quality being 1·0.

Photometrical Studies.—Dr. Rüdorff.

Contribution to the Purifying Question.—M. Cox.—Under this title, the author discusses and elucidates, by a series of experiments, the action of sulphuretted hydrogen and hydrated peroxide of iron.

Comparison of Various Kinds of Gas in reference to its Cost of Production and Illuminating Power.—M. Sautter.

Zeitschrift für Chemie von Beilstein, No. 21, 1869.

This number contains the following original papers:—

Formation of Glycolamidic Acids.—M. Ziegler.—When a concentrated solution of glycocol and monochloro-acetic acid is boiled with chlorinated diglycolamidic acid, the result is triglycolamidic acid; but since, when glycolic acid and ammonia are boiled with the same substances, neither glycol, nor di- and triglycolamidic acid are formed, the author thinks there is no doubt that, when these acids are prepared from ammonia and monochloro-acetic acid, the one is formed after the other, because an atom of hydrogen bound to one of nitrogen combines with an atom of chlorine of the monochloro-acetic acid.

New Mode of the Formation of a Triphenyl-Guanidine.—MM. Merz and Weith.—Equal molecular quantities of aniline, carbanilide, and one-third molecule of trichloride of phosphorus, yield, when mixed, a solid mass, which, while fusing at 140°, effervesces strongly, and, giving off hydrochloric acid, is converted into a basic substance and phosphorous acid (when carbanilide and aniline alone are heated together to about 190°, no reaction takes place). The basic substance just alluded to is, after having been purified, found to be triphenyl-guanidine, fusing at 143°; its platinum compound contains 19·85 to 20·01 per cent metal. This reaction is represented by the following formula:—

$$\left.\begin{array}{l} N\langle^{C_6H_5}_{H} \\ | \\ 3CO \\ | \\ N\langle^{H}_{C_6H_5} \end{array}\right\} + 3C_6H_5.NH_2PCl_2 = \left\{\begin{array}{l} N\langle^{C_6H_5}_{H} \\ | \\ 3C = NC_6H_5 + 3HCl + H_2PO_3. \\ | \\ N\langle^{H}_{C_6H_5} \end{array}\right.$$

100 parts of carbanilide yield 135·3 parts of this basic substance.

Decomposition of Dichlorobromo-Hydrine by Hydrate of Baryta.—M. Claus.—This paper may be briefly summarised in the following words:—It appears that a dispute has arisen between the author and some other scientific chemists, on the subject of the action of baryta and dichlorobromo-hydrine. Among the products of decomposition, propyl-phycitic acid was found by some of the parties; the author now says that that acid is only glycerinic acid and quadriacid-propyl-phycitic alcohol, formerly supposed by the author to exist, has not had its existence proved with sufficient accuracy.

NOTES AND QUERIES.

Glue and Gelatine.—I would feel obliged if any one would refer me to the memoirs which have been published on glue and gelatine or to any special source of information on these subjects.—G. G.

Utilisation of Sulphate of Lime.—Will any of your readers, through your columns, kindly inform me of some process, or some book which treats of such process, by which the sulphate of lime obtained in neutralising the superfluous acid when making Glauber's salt, can be turned into manure or any other saleable article.—GLAUBER.

Gas and Oil Furnaces.—Your correspondent ("Runcorn") I think, would find creosote do for his purpose; it is used by the Government for melting metal, &c., at Woolwich. The heavy tar oil is burnt in contact with steam, perfect combustion thereby taking place. Should he address himself to me at the Post Office, near Mark Lane, Fenchurch Street, I would give him the necessary information.—R.

Testing Lemon-Juice.—I wish to know what process is followed by analytical chemists in testing concentrated lemon-juice as used by calico printers—viz., to ascertain quantity of citric, tartaric, sulphate, and oxalic acids, chlorides, iron, or any other contaminations contained therein—and should feel obliged if you would, through the medium of your valuable paper, give me the name of some work where I could meet with the information.—A. S.

Bronze for Leather.—Can any of your readers give me the composition of the dye used in giving a rich reddish brown metallic (bronze) appearance to leather? It is altogether a vegetable dye—or, at least, it is either animal or vegetable—because it leaves no residue on combustion. Your correspondent refers to the bronze now so general on ladies' boots and shoes.—A CONSTANT READER.

Reducing the Metal from Impure Chloride of Zinc.—(Reply to "An Old Subscriber.")—Not having stated what are the impurities, it is somewhat difficult to advise on the subject, but perhaps the following plan will answer:—Make a moderately strong aqueous solution of the chloride; add powdered dry chalk in a very slight excess. You thus obtain carbonate of zinc, while chloride of calcium will be in solution. Wash the carbonate of zinc, dry it, and mix it with powdered charcoal and some crude oil, taking care to have excess, by weight, of the former of these substances. Place this mixture in a fire-clay retort, or apply the well-known English zinc-melting method. You will require a very strong heat. The zinc, being a volatile metal, will distil.

Acacia Charcoal.—Japanese Fireworks.—Acacia charcoal is now given as a medicine, sold at a high price, the vendors averring that acacia charcoal, and acacia charcoal alone, is the only efficacious material; in fact, that no other charcoal "need apply." I doubt this. Will any of your chemico-medical readers kindly give me information, or an opinion on the subject.—The pretty little Japanese fireworks, for which I sent you a formula once upon a time, have frequently failed in the hands of my friends. I find the cause to be the enormous degree of adulteration in the flour sulphur; crystallise this from benzol, and all goes well; in this case, an additional part of sulphur is required. Roll brimstone would probably be pure enough. —R. TREVOR CLARKE.

MEETINGS FOR THE WEEK.

MONDAY, Dec. 13th.—Royal Geographical, 8.30.
—— Medical, 8.
—— London Institution, 4.
TUESDAY, 14th.—Photographic, 8.
WEDNESDAY, 15th.—Society of Arts, 8.
THURSDAY, 16th.—London Institution, 7.30.
—— Royal, 8.30.
—— Chemical, 8.
—— Zoological, 4.
FRIDAY, 17th.—Quekett Club, 8.
—— Royal Institution, 8.

TO CORRESPONDENTS.

John A. R. Newlands, F.C.S.—Declined, with thanks. Such purely theoretical speculations occupy more space than we can now spare.

C. R. C. Tichborne.—Received, with thanks.

A Subscriber.—A work on the subject is in the press. It will be announced in these columns.

BOOKS RECEIVED.

The Chemistry of Silesian Sugar-Beets. By Dr. Augustus Voelcker. London: W. Clowes and Sons.

The Life and Letters of Faraday. With portrait and woodcuts. By Dr. Bence Jones, F.R.S., &c. London: Longmans and Co.

The Mechanic. Part 21, for December.

A Manual of Diet for the Invalid and Dyspeptic, with a Few Hints on Nursing. By Duncan Turner. London: John Churchill and Sons.

The Development of the Idea of Chemical Composition. By Alexander Crum Brown, M.D., D.Sc. Edinburgh: Edmonston and Douglas.

Just published, demy 8vo., price 6d.

On English and Foreign Alkalimetrical and Chlorimetrical Degrees, by John Pattinson, F.C.S. Read before the Newcastle Chemical Society.

London: CHEMICAL NEWS Office, Boy Court, Ludgate Hill, E.C.

The Mysteries of Udolpho.—Astounding Effects!! Innumerable Ghosts appear and disappear!! Three emanate from One!! The Scenes by Fid. Beetles crawl the Dungeon.—Occasionally, AMSTERDAM and its EXHIBITION, visited by Professor Pepper.—PECULIAR PEOPLE OF THE PERIOD, By Messrs. Wardroper.—ACCREDITED RELICS of the late MAXIMILIAN. The GREAT LIGHTNING INDUCTORIUM is being increased in power: the wonder of the age and science.—THE MYSTERIOUS HAND.—PETIT CONCERT, introducing Herr Angyalphi, the justly renowned Basso Profundo, the Misses Campbell, and Herr Schalkenbach on the Electric Organ. —ROYAL POLYTECHNIC.—One Shilling.

In 2 vols., 8vo., with Portrait and Woodcuts, price 28s.

The Life and Letters of Faraday.—By Dr. BENCE JONES, Secretary of the Royal Institution.

London: Longmans, Green, and Co., Paternoster Row.

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A Manual of Qualitative Analysis. By Robert GALLOWAY, F.C.S., Professor of Applied Chemistry, Royal College of Science for Ireland.

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THE CHEMICAL NEWS.

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ELECTRICITY IN PLANTS.

By EDWIN SMITH, M.A.

THERE is a very interesting chapter in Becquerel's smaller treatise (in three volumes) on "Electricity and Magnetism" concerning the electrical phenomena of plants. I was induced, by reading this chapter, to make a series of experiments, with a view to illustrate the author's statements, and, if possible, to throw some fresh light upon an obscure and puzzling subject. I am now going to put together some notes of these experiments, carefully made at the time, in the hope that they may not be without a certain interest to others. The galvanometer employed is a home-made one, but tolerably sensitive. My greatest difficulty has been to depolarise the slips of platinum by means of which I have made the voltaic circuits; but every care has been taken, to the best of my ability, to obviate error arising from this cause, as well as from thermo-electric disturbance.

Experiment 1.—Take the thick, juicy leaf-stalk of the common garden rhubarb, and, having cut off a length of from 4 to 18 inches, apply a square of platinum foil to each end of the piece. Connect, by means of platinum wire, these two plates with opposite terminals of the galvanometer. The needle will be powerfully deflected. Now reverse the position of the rhubarb between its platinum surfaces, connect as before, and the needle will again be deflected, but in an opposite direction. Having previously ascertained how to interpret the movements of the needle, by noticing its behaviour when a voltaic current is produced between zinc and diluted acid, with platinum for negative plate, and transmitted through the coil, you will at once conclude that a current of electricity is passing from that end of the leaf-stalk nearest the root towards the opposite end, nearest the blade of the leaf.

Experiment 2.—Cut off a piece about 3 inches long from the thickest part of the same leaf-stalk. Divide it longitudinally down the middle. Pare off a level slice of the outer cuticle. Lay the platinum slips close to the two flat sides thus provided, and connect with the galvanometer. There will be indicated a current from the outer side nearest the cuticle to the inner axis of the leaf-stalk. If the section is made thinner, there will be a current in the same direction. You may confirm your conclusion, as before, by simply turning over the piece of rhubarb, so as to reverse the current. Experiments 1 and 2 may be tried upon a thick midrib or branch of the same, taken from the leaf-blade, with a precisely similar result. A cucumber acts in the same way.

Experiment 3.—Insert a platinum wire into the lower end of the flower-stalk of peony. Apply foil to one of the large bracts, or to a petal; connect, and observe deflection. A current is detected flowing from the lower end of the flower-stalk to the bract or petal. The same experiment may be tried with a sprig of fresh oak-leaves, or bramble, or chickweed, or bunch of elder-buds, or poppy-flower, or stalk and leaves of poppy. The current always sets from the point nearest to the root towards the organs furthest from the root. If wires be inserted in the pistil of a flower and its stalk, there will be shown a current flowing towards the former.

Experiment 4.—Lay a leaf of the common dock between pieces of platinum foil. Connect the different surfaces with opposite terminals of the galvanometer, and notice the deflection. A current is indicated from the upper to the under surface of the leaf. A leaf of Spanish chesnut or of young elder will give the same result; but, in four experiments on a leaf of sycamore, I got a current from the under to the upper surface, after a momentary current in an opposite direction. I infer, however, that the momentary current was the true one, and that the second arose from polarisation; for I obtained this latter current by merely employing filter-paper dipped in distilled water, and laid between the slips of foil.

Experiment 5.—Twist a piece of wire round the outer cuticle of a young twig of hawthorn. Insert a second wire between the bark and wood, so as to touch the layer of cambium. On completing the circuit, a current will be indicated from the cambium to the outer cuticle. Again: pass a wire into the pith, and a current may be detected taking a direction from the cambium to the pith. Instead of hawthorn, a cutting from a fresh branch of elder, laurel, hedge-mustard, thistle, groundsel, yarrow, or other dicotyledonous plant, may be employed, with, as I have uniformly found, the same effect.

Experiment 6.—Scrape off the outer cuticle of the root of cress. By means of wires, as before, test the direction of the electric currents. They will be found to flow from the outside to the axis of the root, and, again, from the root-stock, or point of junction with the stem, towards the lower tapering end. The same effects are exhibited by the root of cat's-ear, or of thistle. If plates of platinum foil are applied to the flat surfaces made by cutting across the thick and thin ends of a carrot, a current will be found to set from the thick end of this root to the smaller end.

Experiment 7.—Take a bunch of the seeds of sycamore. Dip a samara attached to the stalk near its broader end into one of the mercury-cups, and a samara attached to the stalk at a point nearer the smaller end into the other cup. A current is indicated from the former towards the latter, in strict analogy to what happened in the third experiment. Or a piece of the stalk itself may be bent, and its ends dipped into the mercury-cups. A current will be indicated, having the same direction as before. A cutting from any pliable stem may be tried in this way, and always, so far as my experience goes, with a similar result.

Experiment 8.—Pass a platinum wire through the tubular hollow of a stem of *Poa*, or some other meadow-grass. Twist another platinum wire round the outside, and connect both with the galvanometer. A current will be shown, having a direction from the interior to the exterior surface of the stem in question. Such appears to be the law with the stems of monocotyledonous plants.

Experiment 9.—Make two cuts through a raw potato, one through the centre, another near the outer coat. Apply strips of platinum to the two flat surfaces, and connect with opposite terminals of the galvanometer. A current is shown to be passing from the centre towards the outside. A lemon, treated in the same way, furnished a current from the outside towards the centre. With a turnip, a gooseberry, and a pear, the same result was obtained; but a stalk of asparagus followed the law of the potato. A boiled potato, tested, when cold, by the same method, gave a current from the outside towards the centre, the indication being confirmed by a reversal of the slice between the platinum conductors. But, after moistening a fresh piece of boiled potato with distilled water, a current was obtained from the centre towards the outside—a result confirmed by reversing the position of the slice between the platinum conductors, as in the previous trial. Fresh platinum was employed, to obviate, as far as possible, any error from polarisation.

Experiment 10.—Reduce to a pulp with distilled water some of the meal nearest the coat of a baked potato. Then make a similar pulp of some of the meal at the centre. Having placed a plug of tow at the bend of a U-tube, pour the pulps thus prepared into different limbs. Connect, by slips and wires of platinum, with the galvanometer. In my experiment, a current was indicated from the outer pulp towards the inner pulp, agreeably to the result of my first experiment with a slice of boiled potato. My object was to destroy all vitality in the tuber by

boiling or baking, and to see whether any chemical action might still remain—sufficient to cause a voltaic current when meal from different parts of the potato was made to furnish a voltaic couple.

Experiment 11.—Having procured a garden nasturtium growing in a flower-pot, insert a wire in the fleshy stem, a few inches above the soil. Then thrust a second wire through the small hole at the bottom of the pot into the soil. Connect with galvanometer. The needle is so deflected as to indicate the passing of a current from the plant to the soil in which it grows. Watering the soil made no change in the direction of the current when I performed the experiment. I also stuck the first wire into the stem in various ways and in various parts, always with the same results. At the same time, a current was detected passing from the root end towards the leaf end of the stem, conformably to the rule in other cases.

Experiment 12.—Make a solution of oxygen in distilled water, also a solution of carbonic acid. Pour them into the different limbs of a U-tube furnished with a plug of tow. Insert platinum slips, and connect with galvanometer. There will be a marked deflection of the needle, showing the passage of an electric current from the oxygen to the carbonic acid. Confirm the result by reversing the platinum connectors.

The foregoing series of experiments are enough to set one thinking; but I feel that it would be premature to reason upon them at present, even with the admirable clue afforded by the treatise of M. Becquerel. I should like to compare, for instance, the electrical phenomena of plants in spring and in autumn, to see how far they are affected by the condition and flow of the sap.* In a future paper, I may, perhaps, be permitted to return to the subject, and attempt some *rationale* of the curious order of facts above-described.

ON THE

ESTIMATION OF IODINE AND BROMINE,

WITH SPECIAL REFERENCE TO THE

ANALYSIS OF KELP.†

By R. R. TATLOCK, F.C.S.

THE methods for the estimation of iodine and bromine in presence of chlorine that have been devised from time to time are exceedingly numerous, but, in many cases, very unsatisfatory. They generally require either extreme skill and nicety on the part of the operator (a very small error in the manipulation seriously affecting the results), or they are so tedious and inapplicable in most ordinary circumstances as to be of little value. These remarks apply specially to methods that have been described for the estimation of iodine in kelp, in which the presence of bromine is either overlooked or ignored, although its existence would render such methods totally inapplicable.

The object of the following note is to describe a method for the determination of iodine, bromine, and chlorine, in presence of each other, which I have followed for many years, and which has been perfectly successful in the analysis of kelp. It is not intended to supersede other methods, but merely to take its place along with them, its simplicity in the hands of indifferently-skilled chemists rendering it suitable for adoption in the manufacturer's laboratory, a quality which will be valued more particularly in Glasgow—the seat of the iodine manufacture; while, in point of accuracy, it leaves nothing to be desired.

The method, like that of Frederick Field (*Chemical Gazette* for 1857, No. 357), is based upon the wide difference between the equivalents of iodine, bromine, and chlorine; but the mode of procedure is totally different from that of Field, and is not open to an objection which Fresenius has taken to that gentleman's process of determing these three elements. It depends upon the displacement of iodine by bromine, and of iodine and bromine by chlorine. I shall proceed to give the method in detail before referring to its application in the analysis of kelp.

1. The solution containing the iodide, bromide, and chloride, preferably in combination with an alkali metal, is divided into three equal portions, or, at any rate, three equal portions of it are drawn off. To the one, solution of silver nitrate is added in excess, to precipitate the whole of the I, Br, and Cl. The fluid is then feebly acidified with pure nitric acid, warmed, and agitated till the precipitate settles. This is collected on a small weighed filter, washed with hot water, dried as far as possible at 212°, removed from the filter, dried perfectly by heating to incipient fusion, and weighed, the weight of the small portion adhering to the filter being added, and the weight of the whole noted as—

$$AgI+AgBr+AgCl.$$

2. Another portion of the solution is transferred to a small basin, and a quantity of pure bromine-water added. The mixture is then carefully evaporated on an open water-bath, more bromine-water being added from time to time, till the escaping vapours no longer turn starch-paper blue on a fresh addition—showing that all the liberated iodine has escaped. To ensure excess, a little more aqua-bromine is added, and the solution evaporated to complete dryness. The dry residue is then drenched with water, and the result heated till again dry: this operation is repeated two or three times, to ensure the complete expulsion of any hydrobromic acid that may have been present in the bromine-water. The residue, which now consists solely of alkaline bromide and chloride, is dissolved in water, silver nitrate added in excess, the solution acidified, and the precipitate collected and weighed in the usual way. It is noted as $AgBr+AgBr+AgCl$.

3. The last portion of the solution is brought into a small basin, and a quantity of strong chlorine-water added, to effect the liberation of the iodine and bromine. The mixture is then evaporated till all colour is gone, and some more chlorine-water added. If the solution remains colourless, the whole of the iodine and bromine has been expelled, and the alkali metal will exist entirely as chloride. The solution is then brought completely to dryness, after which it is evaporated with a few drops of water two or three times, to expel any hydrochloric or hydrobromic acid. The dry residue is dissolved in water, the solution acidified with pure nitric acid, silver nitrate added in excess as before, and the chloride of silver collected as usual. Its weight is noted as—

$$AgCl+AgCl+AgCl.$$

It is obvious that we have now data from which we can calculate the amounts of iodine, bromine, and chlorine present; for, as the equivalent of bromine is less than that of iodine, in the proportion of 80 to 127, the second precipitate, in which the iodine is replaced by bromine, must weigh proportionately less than the first; and, as the equivalent of chlorine is less than that of either iodine or bromine, in the ratio of 35·5 to 127 in the one case, and 80 in the other, the last precipitate must weigh still less than the second, and we can thus, from the observed differences, deduce the exact quantities of the three elements present.

Example:—

1. $AgI+AgBr+AgCl$	weighed	15·57
2. $AgBr+AgBr+AgCl$	,,	14·69
3. $AgCl+AgCl+AgCl$	,,	12·20

Then—

I.		II.		Observed difference.
15·57	−	14·69	=	0·88

Loss for 1 equiv. I.		Observed loss.		1 equiv. I.		I present.
47	:	0·88	::	127	:	2·378

* My experiments were most of them performed last spring.

† Read before the Glasgow Philosophical Society (Chemical Section), December 6th, 1869.

I.		III.		Observed difference.
15·57	−	12·20	=	3·37

But, as a portion of this loss is caused by the replacement of iodine by chlorine, namely,

Equiv. of I.	Loss in replacing 1 equiv. I by Cl.	I found.	Loss accounted for by I present.
127 :	91·5 ::	2·378 :	1·713

Observed loss.	Loss accounted for by I present.	Difference for Br.
3·37	− 1·713	= 1·657

Loss for 1 equiv. Br.	Observed loss on account of Br.	1 equiv. Br.	Br. found.
44·5 :	1·657 ::	80 :	2·978

Then, as the proportion of iodine and bromine are already known, it will be an easy matter to calculate them to iodide and bromide of silver, and deduct their weight from precipitate 1, calculating the remainder (chloride of silver) to chlorine thus:—

I.	AgI.	I present.	AgI.
127 :	235 ::	2·378 :	4·400

And—

Br.	AgBr.	Br. present.	AgBr.
80 :	188 ::	2·978 :	6·998

Then—

AgI	4·400
AgBr	6·998
	11·398

Then—

15·57 − 11·398 = 4·172

Then—

AgCl.	Cl.	AgCl.	Cl.
143·5 :	35·5 ::	4·172 :	1·032

We had, therefore, present in the solution—

Iodine	2·378
Bromine	2·978
Chlorine	1·032

The bromine water may be easily obtained free from chlorine by distilling bromide of potassium in solution with less potassium dichromate than is necessary to expel the whole of the bromine, using, of course, a little hydrochloric acid.

We now come to the application of the above method to the analysis of kelp.

It is quite obvious that this process cannot be directly applied to substances containing I, Br, and Cl, in very different proportions, and consequently it cannot be used for the estimation of these elements in kelp immediately. The following method of treatment will be found to equalise as nearly as necessary the proportions of the three:—

2000 grs. of the kelp are digested in hot water, the solution allowed to settle, and the clear liquor filtered. The residue is boiled two or three times with water, the fluid being filtered in each case, and the residue finally brought on a filter and washed with boiling water. The filtrates and washings are neutralised as nearly as possible with hydrochloric acid, and chlorine gas passed into the solution till the latter becomes of a distinct orange colour, due to the liberation of iodine and bromine.

The fluid is then shaken up with about one-fourth of its bulk of carbonic sulphide, which takes up the liberated iodine and bromine, and carries them in solution to the bottom of the vessel, provided the specific gravity of the kelp solution be not higher than that of the carbonic sulphide. When this is not the case, the solution of kelp may be diluted till the carbonic sulphide sinks.

The bottom fluid, containing the iodine and bromine, is then drawn off by a fine syphon, and shaken up with an equal volume of water and some zinc-filings. The solution is soon decolourised, on account of the formation of zinc iodide and zinc bromide, which pass into the water; and we have thus a watery solution of the two latter salts above, and colourless carbonic sulphide at the bottom. The latter is drawn off by a syphon, and restored to the kelp solution, to which some more chlorine-water is added; and, if a further quantity of iodine and bromine be liberated, the above operations are repeated till the liquor is quite exhausted.

It only now remains to evaporate the solution of zinc salts, divide into three equal portions, and determine I, Br, and Cl as before described.

With regard to the accuracy of the above method, it may be stated that two sets of trials on pure salts gave the following results, 5 grs. of each of the compounds being used in each case:—

Five grs. KI, 5 grs. KBr, and 5 grs. KCl gave—

	grains.
KI	4·97
KBr	4·97
KCl	5·08

Another trial, with the same quantities, gave—

KI	4·96
KBr	4·95
KCl	5·09

These results leave little doubt that the process is accurate and trustworthy, although I do not deny that other experiments are required to establish the method.

ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 267.)

In the old microscopes, constructed before the introduction of the achromatic principle, the want of light was very evident when any but the lowest powers were used; this soon led to the employment of some means of increasing the intensity of the illumination. The usual plan was to place a lens beneath the stage, which acted like a burning-glass, and allowed the light to be increased to almost any extent. When the microscopic object-glass was freed from the chromatic and spherical aberrations, the increase of illumination following the enlargement of its angle of aperture for a time satisfied observers; soon, however, a larger amount of light was, in some cases, found desirable, and it was usual to employ one of the object-glasses (generally the next lowest to the one in use) to concentrate the light upon the object. This simple contrivance is very effective when nothing else but greater intensity is needed, and a foreign ¼ object-glass will make a very good combination for this purpose when suitably mounted. For the next improvement, we are indebted to Mr. Gillett, who added a series of diaphragms; these, in the most improved form, comprised some having marginal as well as central apertures, as it was soon found that the direction of the light had a very important influence. The condenser has since undergone many improvements, each of the three leading opticians modifying it to suit the requirements of their respective instruments. It consists, as now made, essentially of a combination of achromatic lenses closely resembling an object-glass, and fitted with one or more diaphragm plates, which, either separately or in combination, give perfect control over the amount of light admitted and its direction; the details of construction vary

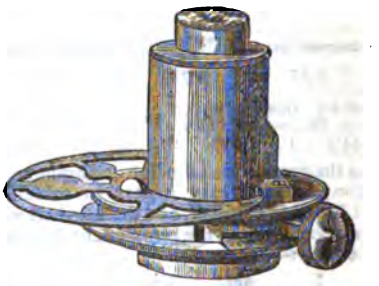
* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

somewhat in different condensers. This is mounted beneath the stage of the microscope with suitable adjustments for focussing, and also for placing it truly in the axis of the instrument, or centering. As the instrument is difficult for the beginner to use, it is well to give a few directions.

The first care will be to centre the condenser, as the spot of condensed light is extremely small, and, should the adjustment not be accurately made, the field of the microscope will be only partially, or not at all, illuminated. The simplest way of centering is to screw on a very low power, and view the setting of the top lens of the condenser; it will then be readily seen whether it occupies the centre of the field, and, should it not do so, the requisite traversing screws are moved until it is found to be accurately in the centre. Or the image of a lamp-flame may be formed with the condenser, and viewed with a moderately-low power, and the screws moved until the image occupies the centre of the field. The focus is then to be adjusted by moving the milled head connected with the proper rack, and a suitable diaphragm turned into place. When the achromatic condenser is used, the flat mirror is to be employed, and if a lamp is the source of light, the rays must be rendered parallel, as before mentioned. Some observers use a prism in the place of a mirror, as it reflects more light, and of a purer quality, than a silvered glass, which gives a reflection from its upper as well as its silvered lower surface, which is likely somewhat to interfere with the perfect illumination of delicate objects. Although the most intense light is obtained when the condenser is accurately in focus, it is sometimes preferable to use the condenser somewhat out of focus; for this, as well as the choice of diaphragms, no particular directions can be given, as much depends upon the nature of the object to be viewed, construction of the instrument, and many other circumstances. A little practice, with the help, if attainable, of an experienced microscopist, will be found the best means of mastering the use of this rather difficult instrument. It is an instructive exercise to place a suitable object upon the stage—a Diatom, for instance—and notice the changes in appearance produced by altering the focus of the condenser and using different diaphragms; so varied are the kinds of marking produced on some of the *Diatomaceæ* by changes of illumination, that it would hardly be believed that the object was the same. It is now tolerably certain that the striæ, or lines, whether single or crossed, and the dots, seen on some of these objects, are non-existent, being merely the optical rendering of closely-packed transparent hemispheres. These were observed some years ago by Mr. Wenham, with a 1-50th objective of his own construction, and quite recently by a new and comparatively simple means of illumination discovered by the Rev. J. B. Reade, and described by him in the *Monthly Microscopical Journal* (1869, vol. ii., p. 5). The instrument used is an equilateral triangular prism, which is so adjusted as to reflect an oblique beam of parallel rays. With this illumination, the hemispheres on *Pleurosigma formosum* may be seen with a power so low as a ½, provided the angle of aperture be sufficient. This simple illuminator may probably be of great value for other purposes, besides viewing the surfaces of *Diatomaceæ*; at present however, it has been so short a time in use, that its full capabilities have not been tested.

More recently, a condenser, constructed on a different principle, has been introduced, the optical portion closely resembling the Kellner eye-piece, instead of following the usual pattern, which is derived from the object-glass. This condenser (Fig. 31), now well-known as the "Webster," is a most efficient

Fig. 31.*



instrument, and, from the simplicity of its construction, is capable of being adapted with advantage to small microscopes. The amount of light given by it is considerable, so great that with the full aperture it is almost more than the eye can bear; this excess of light, if it can be considered as a fault, is certainly a good one, as it permits a very extensive use to be made of diaphragms. The graduating diaphragm (Fig. 32)

Fig. 32.*

can be applied to the Webster condenser with the greatest advantage, and its effect is much more marked than when merely used below the stage to control the illuminating pencil from the mirror. The wheel above the graduating diaphragm consists of a series of central and lateral stops, by the use of which a great variety of oblique and dark field illumination can be obtained; the latter far more efficiently than by the use of the ordinary spotted lens. Recently, a revolving carrier for additional diaphragms has been added to this condenser. It consists of a tube sliding into the lower part of the condenser, and provided at its upper extremity with a contrivance for holding a disc of card or thin brass, in which one or more apertures may be cut. By turning the diaphragm-holder round, the oblique pencil may be directed from any azimuth, and the effect on such objects as the *Diatomaceæ* is very marked indeed, the striæ appearing and disappearing as the aperture is moved to, or away from, the proper angle for bringing them out. This contrivance also allows the observer to try any forms of stop he may consider advantageous, as they may be quickly cut out of a piece of blackened card (B. W. Richardson, *Quarterly*

* For these woodcuts we are indebted to Mr. Collins, of Great Titchfield Street

Microscopical Journal, vol. vi., pp. 10, 86). The long focus and large field of the "Webster" render it particularly useful for the general purposes of the student, as it will work into some depth of water, and can be used for illuminating the interior of the troughs so frequently employed in observing living aquatic animals and plants. Although surpassed by the more costly instruments for the most refined description of illumination, it possesses merits peculiarly its own, and no single piece of apparatus can be made to perform so great a variety of offices as this very useful condenser.

The most useful forms of illuminating apparatus have now been described; there are many others, chiefly meant for special purposes—they will be found in the works of Quekett and Carpenter, and the pages of the *Microscopical Quarterly* and *Monthly Journals*, to which the student is referred for descriptions and figures.

(To be continued).

ON THE

CONSTITUTION OF THE COMPOUNDS OF SODIUM.

By J. ALFRED WANKLYN, F.C.S.

Some degree of astonishment was expressed when, having discovered that ethylate of sodium and acetic ether give alcohol and an isomer of butyrate of soda, exhibiting a cleavage into alcohol and acetic acid, I did not follow the usual practice of regarding sodium as monatomic, but formulated the new compound as containing a triatomic metal. One of my chemical friends, who appeared to be unable to contain himself, pointed out to the Chemical Society of Berlin that my new compounds could be represented in the ordinary way, and, in accordance with this notion, formulated them as compounds of sodinated-ethyl, wherein the metal, regarded as monatomic, had replaced an equivalent of the hydrogen which, in union with carbon, constituted ethyl in the original compound.

I will, on the present occasion, adduce a reason which will be regarded as decisive against the ordinary formula. If the new compound were really a salt of sodinated-ethyl, it should admit of the replacement of its sodium by ethyl, and, as the result of such an operation, should give acetate of ethylated-ethyl (*i.e.*, acetate of butyl). Now, nothing of the sort takes place. Iodide of ethyl, which is the proper reagent for effecting such replacements, does not produce iodide of sodium and acetate of butyl when it is made to act on my new isomer of butyrate of soda. Neither does the "absolute ethylate of sodium" (which my Berlin friend would write as hydrate of sodinated-ethyl) produce butylic alcohol by a similar treatment. The absence of such transformations, and the actual course taken by the action of the iodide of ethyl on these substances, are, to my mind, conclusive against the formulæ which my chemical friends wanted me to assign to the new isomers of the sodium salts of the fatty acids.

Furthermore, I am unacquainted with any really cogent reason for assigning to sodium a mono-valent function, even in the common, every-day sodium compounds. As yet, no vapour density determination has been made of any compound of sodium. Some nine or ten years ago, in a paper urging the di-valent nature of zinc and mercury, I pointed out that no metallic chloride, or other metallic compound, had been shown to present only one atom of chlorine or other representative of hydrogen in the standard, two volumes constituting the vapour-unit to which vapour densities are referred. The same remark holds good to-day; and, most probably, when chemists have taken the vapour density of common salt, there will be found two atoms of chlorine in the vappur unit.

The facts of the evolution of hydrogen when sodium acts upon water, of double decompositions taking place between salts of sodium and salts of other metals, are not more in accordance with the view that the metal is monovalent than with other views.

On the other hand, the researches in which I have been engaged have constantly exhibited the polyvalency of sodium. I do not know any chemical compound which shows a greater tendency to enter into double compounds than does absolute ethylate of sodium. With HCl, C_2H_3OCl, H_2S, and C_2H_6O, it forms double compounds. With CO_2, it combines, forming a double compound. With NH_3 and CO, there is no action at all, even at 200° C.—neither combination nor reaction to yield separated products. Iodide of ethyl alone (and even this is a doubtful point) may possibly react without preliminary formation of a double compound.

Now, this constant tendency to form doubles is the criterion of polyvalency. Oxygen was regarded as divalent mainly because there are double oxides of the alcohol radicles and no corresponding double chlorides.

The following is a list of compounds wherein the trivalent character of the metal is apparent:—

1. Double compound of sodium-ethyl and zinc-ethyl .. .. $Na'''\{(ZnC_2H_5)'', C_2H_5, C_2H_5$
2. Sodium-triacetyl .. .. $Na'''\{C_2H_3O, C_2H_3O, C_2H_3O$
3. Absolute ethylate of sodium .. .. $Na'''\{O\}C_2H_4$ H
4. Double compound of absolute ethylate with hydrochloric acid $Na'''\{(OC_2H_5)'', H, Cl$
5. Double compound of absolute ethylate with sulphuretted hydrogen .. .. $Na'''\{(OC_2H_5)'', H, (SH)'$
6. Double compound with chloride of acetyl .. .. $Na'''\{(OC_2H_5)'', C_2H_3O, Cl$
7. Acetate of ethylene-sodium .. .. $Na'''\{O\}C_2H_4$ C_2H_3O
8. Valerianate of ethylene-sodium .. $Na'''\{O\}C_2H_4$ C_5H_9O
9. Benzoate of ethylene-sodium .. $Na'''\{O\}C_2H_4$ C_7H_5O
10. Absolute amylate of sodium .. $Na'''\{O\}C_5H_{10}$ H
11. Acetate of amylene-sodium .. $Na'''\{O\}C_5H_{10}$ C_2H_3O
12. Valerianate of amylene-sodium .. $Na'''\{O\}C_5H_{10}$ C_5H_9O

All of these bodies have been actually obtained, and will be found mentioned in my papers. In order to form an adequate idea of the numerical strength of this material, it should be borne in mind that the examples on the above list have, to a great extent, the character of typical cases. Thus, Nos. 7, 8, 9, 11, and 12 are members of one class whose numbers are very moderately computed at ten thousand. And it should, also, not be forgotten that there has, as yet, been no general movement among chemists in search of double sodium compounds, but that search has been confined to one solitary chemist.

It will be observed that, although I continue to look upon sodium as tri-valent, yet that some alteration has been made in the formulæ of absolute ethylate of sodium, and of the isomers of the sodium-salts of the fatty acid. At first, I wrote—

$$Na''' \begin{cases} (C_2H_4)'' \\ OH \end{cases}$$

now I have transferred the oxygen from the hydrogen to the ethylene, and, in place of regarding sodium as two-thirds saturated with ethylene and one-third with hydroxyl, I now regard sodium as one-third saturated with oxygen, one-third with ethylene, and one-third with hydrogen.

Adopting this modification of the formulæ, the various metamorphoses of the compounds may be exhibited with great simplicity and regularity. In particular, the reaction between iodide of ethyl and acetate of ethylene sodium (at first sight one of formidable complication) becomes regular and intelligible when viewed in the light of the new formulæ; it consists in the production of iodide of sodium, alcohol, and caproate of acetylinated ethyl:—

$$Na''' \left\{ \begin{matrix} OC_2H_4 \\ | \\ (C_2H_3O) \end{matrix} \right\} Na''' \left\{ \begin{matrix} OC_2H_4 \\ | \\ (C_2H_3O) \end{matrix} \right\} + 2C_2H_5I =$$

$$= Na_2I_2 + \left\{ \begin{matrix} C_2H(C_2H_5)_2O \\ | \\ OC_2H_4(O_2H_3C) \end{matrix} \right\} + OC_2H_4H_2.$$

In the above list, sodium has always been written as tri-valent; it is, however, right to add that I am prepared to consider the metal as being five-valent in the double compounds of ethylate of sodium with hydrochloric acid, sulphuretted hydrogen, and chloride of acetyl. I have, on other occasions, contended that sodium is seven-valent in the crystalline compound of the ethylate with three molecules of alcohol. As will be gathered from my various papers on this subject, I regard sodium as never *monovalent*, but as tri-, five-, seven-valent, and perhaps even higher. This paper has been restricted to organic compounds; on another occasion, I propose to exhibit the inorganic compounds of sodium in a new light.

London, December 11th, 1869.

ON SOME

TECHNICAL APPLICATIONS OF THE SPECTRUM MICROSCOPE.*

By H. C. SORBY, F.R.S., &c.

(Continued from p. 280.)

On the Age of Dark Wines.

In order to obtain good results considerable care is required, and after trying several methods I found the most satisfactory was as follows:—I have two experiment cells one inch long, made from stout tube, having an internal diameter of about a quarter of an inch. Both ends are cut square, and one is fastened to a piece of glass like a microscopical object by means of purified gutta percha. This I find a most valuable cement for such purposes, since it resists the action of alcohol, acids, and alkalies. The glass must be heated until the gutta percha is sufficiently soft. One of the tubes is carefully graduated into ten equal parts, and the other left plain. Wine in its natural state is often much too dark coloured to enable us to recognise the effect produced by adding sulphite of soda, when we examine the spectrum of the thickness of one inch. It is, therefore, requisite to dilute it with so much of a mixture of one part of alcohol with three of water that the spectrum of the light which has passed through the experiment cells may show a strong, but by no means complete, absorption of the light in the yellow and in the yellow end of the green. After diluting some of the wine to this extent, and adding so much citric acid that it may have a very strong acid reaction, it should be poured into two test-tubes, powdered sulphite of soda dissolved in one, and the other kept without. Though the sulphite may produce a very considerable change at once, the alteration is not complete for awhile, and therefore it is best to keep the solutions for an hour or two in the tubes, corked up to prevent evaporation. The point to be then determined is, how much less thickness of the diluted wine to which no sulphite has been added will give exactly the same intensity of absorption in the yellow, and in the yellow end of the green, as the thickness of one inch of the same acted on by the sulphite of soda. The ungraduated tube should, therefore, be filled with the latter, and a small piece of thin glass placed on the top, so that the light may pass through exactly one inch in thickness of the liquid, and none run out when the tube is placed in an inclined position on the side stage of the spectrum eye-piece. The diluted wine should then be introduced into the graduated tube, which is placed nearly vertically on the ordinary stage of the microscope, and the depth of the liquid carefully regulated by means of a pipette, so that the intensity of the absorption in the two spectra may be exactly the same in the yellow and in the yellow end of the green. The light must be of the same intensity in both spectra; and, therefore, it is also particularly necessary so to regulate the instrument that the transmitted red rays may be of exactly the same brilliancy. The accuracy of this experiment is limited by the difficulty of recognising when the transmitted and the absorbed rays are equal in both spectra, and by its being difficult to determine the depth of the diluted wine to less than 1-100th of an inch. The actual value of the measurements varies, to some extent, according to the manner in which the experiments are made; and, therefore, I strongly advise any one who may wish to employ this method to prepare for himself a table of the comparative amount of change of wines of various ages.

When sulphite of soda is added to a faded solution of the colouring matter of fresh dark grapes it is changed to a pale orange yellow, which colour is, I believe, due in great measure, to the presence of the same yellow substance as is met with in green grapes, so that the intensity of absorption is reduced to about 1-10th, or from 1·00 to 0·10. In the case of the perfectly new wine prepared by myself, the intensity of absorption was reduced from 1·00 to about 0·22. My experiments with the wines of commerce were chiefly made in April, 1868. The newest port wine that I was able to examine was of the vintage of 1866, and therefore about one year and a half old, and even this contained a good deal of the C colour. I examined several specimens of the same vintages of various older dates, which differed considerably in general colour and character, but when all had been kept for the same time in the casks I did not find any material difference in the general results. From the manner in which the experiments were made, the change produced by adding the sulphite of soda is referred to the amount of the C colour taken as unity; and, assuming that the extent to which the wine has been altered by keeping is the difference between the amount still unchanged and unity, the numbers given indicate the relative changes produced by the slow action of the air, but they can only be looked upon as expressing the rate of one particular kind of change. The following table has been constructed from the whole of my observations, so as to give a good general illustration of the subject.

Column 1 shows the age of the wine in years and the date of the vintage.

Column 2 gives the thickness of the diluted wine without sulphite, which produced the same intensity of absorption as 1·00 inch of that to which the sulphite had been added.

Column 3 shows the difference between the values in column 2, divided by the number of years between each

* Communicated by the author, having been published in the *Quarterly Journal of Microscopical Science*, vol. ix., new series, p. 358.

two, so as to exhibit the amount of change for each year, after the wine had been kept for the various periods:—

I.		II.	III.
0	(Made by myself)	0·22	
1½	(1866)	0·63	0·2700
2½	(1865)	0·70	0·0700
3½	(1864)	0·73	0·0300
4½	(1863)	0·75	0·0200
5½	(1862)	0·76½	0·0150
6½	(1861)	0·78	0·0150
9½	(1858)	0·80	0·0070
16½	(1851)	0·82	0·0030
20½	(1847)	0·83	0·0020
33½	(1834)	0·84	0·0008
47½	(1820)	0·85	0·0007

Since the above table does not refer to wines of even years of age, I subjoin below another derived from it by laying down the results on paper as a curve, and interpolating by careful measurements:—

I.	II.	III.
0	0·220	
1	0·550	0·330
2	0·670	0·120
3	0·720	0·050
4	0·742	0·022
5	0·760	0·017
6	0·772	0·012
7	0·782	0·010
8	0·790	0·007
9	0·795	0·005
10	0·800	0·005

It will thus be seen that the rate at which the B colour changes into C is far more rapid in the case of new wine, when much of it is present, than after the wine has become older; being, in fact, about ten times as rapid in the first year as in the third, and about 100 times as rapid as in the twentieth. On this account, the difference for each year is at first so considerable that wines of different vintages could easily be distinguished; but after about six years, the difference is so small that it would be difficult, or impossible, to determine the age to within a single year. After twenty years, a difference of even ten years does not show any striking contrast, and the age could not, therefore, be determined to nearer than ten years by this process. However, up to six years I think it quite possible to determine the age to within a single year. I took specimens of various ports from the casks, of different ages up to six or seven years, and labelled them in such a manner that I did not know the age of any, but could ascertain it afterwards by reference. I then made the experiments with great care, and found that, by proper attention to the details described above, I could correctly determine the year of vintage of each particular specimen.

As already mentioned, the change of the B colour into the C is most probably the effect of the oxygen of the air, which appears to act slowly through the wood of the cask; but the relative amount of these two colours is also modified by the deposit of crust. When kept in well-corked bottles, the change does not appear to be the same, and goes on far more slowly. I therefore think it would be scarcely possible to ascertain the length of time that the wine had been in bottles, and am inclined to believe that the amount of change observed on adding sulphite of soda corresponds more closely with the time that the wine had been previously kept in the cask. I have especially observed this in the case of Bordeaux and Burgundy wines. Those of this type which I have hitherto examined seem to contain a larger relative amount of the B colour, when a few years old, than ordinary ports, and in this respect agree with the so-called *natural port*; but the rate of change is greater when they are kept for some years, probably owing to their containing a less amount of alcohol. There is also a greater variation in different samples of the same age than I have met with in port wine, which is probably because the amount of alcohol in such wines varies more in proportion to the total quantity.

It appears, therefore, that the natural colour of dark grapes is changed by oxidisation into the somewhat similar colour found in new wines, and that, by still further oxidisation, this is converted into another entirely different colour, which becomes much paler by further oxidisation. The rate at which these changes take place varies according to circumstances, but, other things being equal, it varies according to the time of the action. Much also depends on the deposition of colour in the form of crust, and after a long time the original dark coloured substance is almost entirely lost, and only an amber colour remains in solution, which behaves with reagents precisely like that in sherry wines.

On White Wines.

The colouring matter of white wines appears to be derived from one of those yellow substances, soluble in water, of which there are several of materially different character in the faded leaves of different kinds of plants, as more fully described hereafter when treating on hops. That met with in the orange-coloured leaves of the beech is a good example. The depth of the colour is made nearly ten times as great by the addition of ammonia, and when dissolved in strong sulphuric acid diluted with an equal bulk of water, oxidising reagents first turn it much darker, and then much paler. When, however, kept for some months dissolved in dilute alcohol it turns to a much darker tint, and then the solution, with excess of ammonia, is only twice as dark as when made acid by citric acid. Oxidising reagents added to the solution in sulphuric acid do not make the tint any deeper, and thus it appears as if it had been changed by oxidisation into an entirely different colour. The character of this change agrees with what occurs when the colour of dark grapes is oxidised, as already described; and both are good examples of what appears to be a general law. If not already oxidised, a certain amount of oxidisation causes the absorption to advance towards the red end of the spectrum to an extent varying according to the position of the original absorption, and then a still further oxidisation causes the absorption to recede from the red end to considerably beyond the original position, sometimes so much so that all colour is lost. We might thus say that such substances may occur in an unoxidised, in an oxidised, and in a per-oxidised condition. These and similar facts seem also to show that there is an intimate relation between the chemical changes and the particular rays of light absorbed by such substances; but the discussion of this very interesting question would lead me far away from the more immediate subject of this paper.

On comparing the colour of sherry wine with that produced by the action of the air on a solution in dilute

alcohol of the substance in faded beech leaves soluble in water, I was unable to discover any difference, and hence I think we may conclude that it is formed by the oxidisation of the yellow colour of the grapes; but in some wines it is imperfectly oxidised, and they turn darker when exposed to the air.

(To be continued).

NOTICES OF BOOKS.

The Life and Letters of Faraday. By Dr. Bence Jones, Secretary of the Royal Institution. London: Longmans, Green, and Co. 1870. 2 vols., 8vo., with illustrations.

I.

We all remember the terse and pregnant account of the life of Faraday which appeared last year in the *Proceedings of the Royal Society*, and which was written by Dr. Bence Jones. Here we had the broad outlines and main incidents of Faraday's great career; in the work before us we have the details of the picture, the delicate tintings, and careful finish—we have the details of Faraday's life, together with the more prominent incidents which were before known to us. The present "Life" is almost an autobiography; Faraday's letters are frequently quoted *in extenso*, and his manuscripts and journals have been freely consulted. Dr. Bence Jones had at one time hoped that the journals which Faraday wrote when abroad would have been published separately, when, as he remarks, "some portions of his biography would have been in his own handwriting; but it was thought undesirable to divide the records of the different parts of his life."

The principal facts connected with the life of Faraday have been previously enumerated in this journal and elsewhere; we shall assume, therefore, that it is unnecessary to bring before our readers any specially-connected biography, but shall rather content ourselves with noticing here and there some of the less-known phases of a life which we all admire so profoundly, and all so desire to emulate. The desultory character of this notice, therefore, arises from the belief that we have already in our minds, to a greater or lesser extent, a biography of the greatest natural philosopher of our epoch.

In reading Faraday's first letters to Mr. Abbott, which were written when he was twenty years old (1812), we cannot fail to be impressed, not by the amount of knowledge which he had acquired, so much as by the amount of thought which he had exercised. He had already read largely, and had not confined himself by any means to scientific works, but was evidently well acquainted with many of the classics of English literature. These letters are long, somewhat verbose, and decidedly more turgid in style than his later letters; in fact, we notice as we proceed a gradual assumption of that charming simplicity and clearness in writing which all his later compositions possess. An inflated style is the common error of young writers, and it is more often noticed at one certain period of a career, when the writer has rapidly and almost abnormally, so to speak, acquired learning and a taste for expressing his own ideas, than when it has been more gradually amassed, or to a less degree. Faraday had an early opportunity of lecturing, for he joined the City Philosophical Society in 1813, and it was the duty of each member, in rotation, to deliver a lecture. At this time, also, he was in the habit of meeting a few of his more intimate friends for purposes of mutual improvement; they "met of an evening to read together, and to criticise, correct, and improve each other's pronunciation and construction of language."

Shortly after his engagement at the Royal Institution, Faraday wrote several letters to his friend Abbott, on the subject of lecturing, and the qualifications which a lecturer ought to possess (pp. 70-79); these are well worthy the perusal of all who may be engaged in lecturing or science teaching; we find in them many of the precepts which Faraday followed through life, the observance of which made him the most lucid and elegant lecturer of our day. "A lecturer," he writes, "should endeavour, by all means, to obtain a facility of utterance, and the power of clothing his thoughts and ideas in language smooth and harmonious, and at the same time simple and easy. His periods should be round, not too long or unequal; they should be complete and expressive, conveying clearly the whole of the ideas intended to be conveyed. If they are long, or obscure, or incomplete, they give rise to a degree of labour in the minds of the hearers which quickly causes lassitude, indifference, and even disgust." . . . "A lecturer falls deeply beneath the dignity of his character when he descends so low as to angle for claps, aad asks for commendation. Yet have I seen a lecturer even at this point. I have heard him causelessly condemn his own powers; I have heard him dwell for a length of time on the extreme care and niceness that the experiment he will make requires; I have heard him hope for indulgence when no indulgence was wanted; and I have even heard him declare that the experiment now made cannot fail, from its beauty, its correctness, and its application to gain the approbation of all."

During his travels on the Continent with Sir H. Davy, Faraday appears to have kept a careful journal; and this eighteen months of his life, although at times very distasteful, must have had a great effect on the formation of his mind and character, or rather in hastening or ripening his more prominent characteristics. It was, of course, a matter of much benefit to him (too often forgotten by those who speak of his self-education, without any of those advantages which the educated usually possess, &c.) to be in constant communication with one of the most brilliant and profound chemists in Europe, to work with him and for him, to notice the tone and manner of his thought, his treatment of questions of science, his mode of interrogating nature. It was advantageous to see other countries, study other languages, to examine scientifically, and with such a man as Davy, various natural phenomena and results of former phenomena not presented to us in these Islands. We find him one day working at the compounds of iodine (then recently discovered) in the laboratory of the Jardin des Plantes; on another, making the ascent of Vesuvius; he is now burning diamonds with Cosmo de Medici's great lens, now at a masked ball in a domino, or a spectator of the races in the Corso. During his tour, he appears to have had a good deal of time to himself, although, in certain respects, he did not find his post of amanuensis either a sinecure, or exactly what he expected as regards occupation.

Faraday returned to England in 1815, and now commenced his "early scientific training at the Royal Institution." He gave seven lectures during the year at the City Philosophical Society, on various subjects connected with chemistry, and he published his first paper ("An Analysis of Native Caustic Lime") in the *Quarterly Journal of Science*. In concluding his fifth lecture, he says:—"The philosopher should be a man willing to listen to every suggestion, but determined to judge for himself. He should not be biassed by appearances, have no favourite hypothesis, be of no school, and, in doctrine, have no master. He should not be a respecter of persons, but of things. Truth should be his primary object. If to these qualities be added industry, he may, indeed, hope to walk within the veil of the temple of Nature."

Five years later, Faraday, who was then in his twenty-ninth year, commenced what Dr. Bence Jones has well called his "higher scientific education at the Royal Institution." He had for seven years been the private assistant of Davy, and assistant in the laboratory and lecture-room. He had lectured with much success, both in the matter of speech and of experiment, and he had published thirty-seven notices and papers in the *Quarterly Journal of Science*. Yet, with all this, he did not publish the first

of his "Experimental Researches on Electricity" for eleven years from this date; and this period between the end of his first seven years of science-study and the commencement of the publication of these great researches was the time of his higher education in science. Faraday had for many years kept a common-place book. In 1822, he commenced a new and more detail note-book, which he called, "Chemical Notes, Hints, Suggestions, and Objects of Pursuit." In this, we find mention of many researches, which were elaborated and published at a later date. For instance:—

"General effects of compression, either in condensing gases or producing solutions, or even giving combinations at low temperatures. . . .

"State of electricity in the interior and on the surface of conductors, and on the surface of holes through them.

"Transparency of metals. Sun's light through gold-leaf. Two gold leaves made poles—light passed through one to the other."

At a later date, he wrote at the commencement of this collection of notes—"I already owe much to these notes, and think such a collection worth the making by every scientific man. I am sure none would think the trouble lost after a year's experience."

In 1823, Faraday was elected a Fellow of the Royal Society; and other scientific honours now began to be offered him. He received, altogether, ninety-five honorary titles; and of these he said:—"One title—namely, that of F.R.S.—was sought and paid for; all the rest were spontaneous offerings of kindness and goodwill from the bodies named."

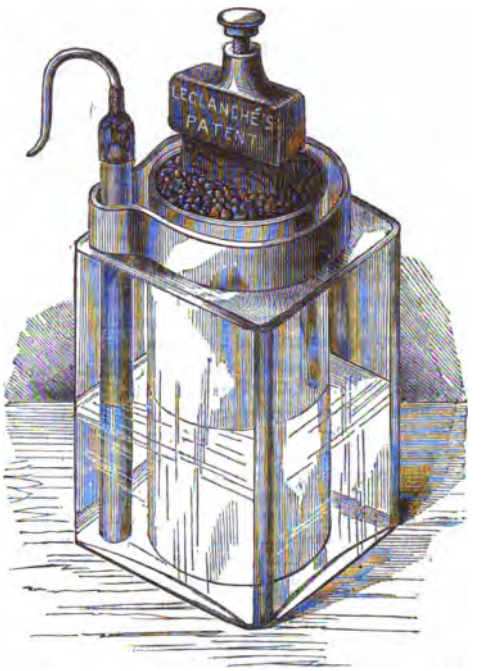
In 1825, on the recommendation of Sir H. Davy, Faraday was appointed Director of the Laboratory of the Royal Institution; and one of his first acts was to invite members of the Institution to attend evening meetings in the Laboratory, at which Faraday showed new and striking experiments. From these meetings sprang the Friday evening discourses so well known to all of us, and the establishment of which probably, remarks Dr. Bence Jones, "saved the Institution."

Let us, now that we have arrived at the last year (1839) of Faraday's higher scientific education, pass in review some of his work, before passing to the commencement of that great series of researches which numbered more than fifteen thousand paragraphs, and was concluded in 1856.

He had already made notable researches on electro-magnetic motions, on the condensation of gases, on the manufacture of glass for optic purposes, and on the alloys of steel. He had discovered two chlorides of carbon, benzol and sulpho-naphthalic acid; and he had made various experiments on the diffusion of gases. Moreover, he had published sixty scientific papers, nine of which were in the *Philosophical Transactions*. Here, then, for the present, we will leave him, in his thirty-ninth year.

Treatise on the Leclanché Battery: Preceded by a Few Remarks on the Employment of Electrical Batteries in Telegraphy. London: The India Rubber, Gutta-Percha, and Telegraph Works Co., Silvertown, Essex, and 100, Cannon Street, London.

IN this pamphlet will be found a full description of the Leclanché cell, the main feature of which is that peroxide of manganese is used with zinc (amalgamated) and an aqueous solution of an alkaline salt, chloride of ammonium being preferred. The author states, and his statement is borne out by comparative experiments made with the Marié-Davy, Daniell, and Bunsen cells, that the Leclanché cell is preferable to any other. The cells are of three sizes, and the shape is shown in the accompanying cut; the smallest, with a porous pot 4·3 inches high, can accomplish an annual electric work which may be represented by 62 grains of copper reduced in the voltameter; the medium size, with a 6-inch porous pot, can reduce from 950 to 1000 grains, while the large size gives a work equal to 1500 or 2000 grains. We have ourselves tried the cell, and can recommend its use to those



who require galvanic electricity for telegraphic or other purposes.

CORRESPONDENCE.

THE METEORIC IRON OF DEESA.

To the Editor of the Chemical News.

SIR,—I find in the CHEMICAL NEWS (vol. xx., p. 274) an abstract of the memoir published by *Cosmos* concerning the meteoric iron of Deesa.

Allow me to observe that the results indicated (except those which relate to the elementary composition of the metallic part) have not been obtained by M. Domeyko, but by myself.

I will add that the examination of the Deesa mass has led me to considerations which I believe to be new on the origin of meteorites.

The characters offered by this mass are such that it is impossible not to perceive in it a specimen of the first *meteoric eruptive rock* hitherto observed.

Consequently, the meteorite mass of Deesa permits us to affirm that meteorites, anciently in *statographical relations*, come from a globe, now broken up, which formerly revolved round the earth.

Finally, the consideration of *meteoric dykes* gives us the relative geological age of meteorites.

I shall be very glad if this letter can find a place in your most valuable journal.—I am, &c.,

STANISLAS MEUNIER,
Docteur ès Sciences,
Aide Naturaliste au Muséum.
23, Rue de Vaugirard, à Paris, Dec. 4th, 1869.

PHOSPHAMIDES.

To the Editor of the Chemical News.

SIR,—In your last number, among the "Chemical Notices from Foreign Sources," is an abstract of a paper by Schiff,

in Beilstein's *Zeitschrift für Chemie*. In that paper he comments on one of mine, and re-asserts the existence of phosphotriamide, $P(NH_2)_3O$; but it is evident that his acquaintance with my communications to the Chemical Society on the various phosphamides is imperfect, and a statement of the different results of our experimenting may not be without its value.

Schiff's statement is that ammonia gas, passed over oxychloride of phosphorus, is capable of eliminating the whole of the chlorine, producing a triamide, thus:—

$$PCl_3O+6NH_3=P(NH_2)_3O+3NH_4Cl;$$

and that this triamide may be separated from the chloride of ammonium by means of water, in which it is insoluble.

My statement is that I have never succeeded in replacing more than two equivalents of chlorine at any temperature, and that the amidated oxychloride thus produced is at once decomposed by water with the formation of pyrophospho-triamic acid, thus:—

$$PCl_3O+4NH_3=PCl(NH_2)_2O+2NH_4Cl, \text{ and}$$
$$2(PCl(NH_2)_2O)+2H_2O=P_2(NH_2)_3HO_4+NH_4Cl+HCl.$$

But, where a high temperature has been employed in saturating the oxychloride with ammonia, the product of the action of water is not the -triamic acid, but what I have called pyrophospho-pentazotic acid, $P_4N_5H_9O_7$.

Schiff's original view rested mainly on one determination of phosphorus and nitrogen in his supposed phosphotriamide, which, however, gave numbers not very accordant with theory, while the phosphorus is nearly the same under either view. In his present note, he rests rather on the fact that the white powder, when heated *per se*, gives off ammonia without any chloride of ammonium, leaving PNO, and losing 36 per cent in weight.

My view rests on a large number of analyses of the two acids and their salts, and on the fact that, in my experiments, the oxychloride of phosphorus could never be made to increase in weight by the absorption of ammonia more than about 44 per cent, while a complete replacement of the chlorine would give 66·3.

It is evident that, under either view, ammonia without any chlorine must be given off when the white substance is strongly heated, and that phosphonitryl, PNO, is a probable result. I have already stated that pyrophosphotriamic acid, heated at low redness, gives off about 10 per cent of ammonia; and in an experiment, made for the purpose of determining how great a loss the substance would suffer when strongly heated, 16·85 per cent was all that could be obtained, and the black fused mass that remained in the tube was not pure phosphonitryl.

That Schiff should obtain a loss of 36 per cent would seem to indicate that he has produced some different compound from any of the acid amides, the formation of which has been my invariable experience.—I am, &c.,

J. H. Gladstone.

17, Pembridge Square,
Dec. 9, 1869.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xiv., No. 2, 1869.

The only paper relating to chemistry in this number is:—

Absorption of Hydrogenium by Iron Galvanically Obtained.—M. Jacobi.—Iron, precipitated galvanically, is described by the author as a silver-grey coloured, velvety-looking, very finely-grained mass, of 7·675 sp. gr. at 15°; this metal is so hard that it scratches glass, but is, also, very brittle. When this metal was very carefully ignited in a covered platinum crucible, its colour became deeper, its hardness and brittleness were lost, and its sp. gr. had increased to 7·811, which is higher than that of wrought-iron. The fact of this increase of specific gravity led the author to conclude that the iron might contain gas absorbed in its substance. A quantity of 9730 grms. were treated in a Sprengel's aspirator, with the result that, aided by an increased temperature, which was carried to dull-red heat, 1776 volumes of gas, chiefly composed of hydrogen, were obtained from the quantity of iron submitted to experiment.

Les Mondes, November 25, 1869.

This number contains the following original matter:—

Speech at the Opening Meeting of the German Naturalists and Physicists, at Insprück.—Dr. Helmholtz.—From this very eloquent and very able speech, we quote the few following phrases:—The discovery of the common tie existing between and uniting together all the phenomena of nature, is the final aim of all science, and towards the reaching of that aim the efforts of all workers of science must be directed; only the knowledge of the laws which rule and govern the material world will enable man to make it obey his will. The speaker, in his discourse, referred briefly to astronomy, as the science of the laws of gravitation; to chemistry, as the science of inalterability of matter and its varied combinations; and next spoke about conservation of forces. At the conclusion, the speaker stated that Germany is, therefore, in advance of all the rest of the scientific world; because, out of that country, and more especially in France and England, scientific men had to heed social, and, far more yet, religious prejudices, and were thereby prevented free utterance of thought, since it would damage their social influence. On the whole, the speech is thoroughly Teutonic in the highest sense of the word, and the terseness, as well as the eloquence of the printed report, cannot fail to imbue the reader with respect for the very sound and able manner wherewith the eminent speaker discussed, extempore, abstruse scientific truths. Under the presidency of Prof. Hlasiwetz, of Vienna, the following papers were read in the chemical section:—(1) On "Iodoform," M. Lieben; (2) "On Lactic Acid," M. Wislicenus; (3) "On Phenylic Brown," M. Rolly; (4) "On Proteine Substances," M. Schwartzenbach; (5) "On the Sulphurets of Nitrogen," M. Claust; (6) "On the Hydruret of Palladium," M. Boettger; (7) "On Anthracen," M. Petersen; (8) "On Hydrargyrodinaphthyl and Phenyl," M. Otto.

Presence of Salt in Sea Air.—Dr. Gillebert d'Hercourt.—From a series of observations made at Monaco, on the shores of the Mediterranean, the author concludes that there is always on the sea shores an atmosphere impregnated with saline particles; this layer of air has, at the above-named place, some 500 metres' horizontal, and some 60 metres' vertical extent. This impregnation of salt is due to what the author terms "pulverisation" of the sea-water by the breaking-up of the surf, and is not directly influenced either by barometric pressure, hygrometric state of the atmosphere, or its temperature. This hydro-mineral dust (*poussière*), as it is called by the author, is, unless there happen to exist near the coast physical obstacles, in the shape of high mountains, carried far away inland, and is not to be confounded with what is of more coarse nature, and termed "spray," which is only quite local, and produced when a gale of wind blows. The author states that, even on calm days in winter, the atmosphere near Monaco is at least up to a height of 70 metres, and some few miles inland impregnated with this hydro-mineral dust. There is no tide (rise or fall of water) perceptible in the sea alluded to.

Journal de Pharmacie et de Chimie, November, 1869.

This number contains the following original papers:—

Researches on the Bleaching of Tissues.—M. Kolb.—The second portion of a lengthy paper on this subject.

On Carlinate of Potassa and Carlinic Acid.—M. Lefranc.—Carlinate of potassa is a white-coloured salt, crystallising in needle-shaped crystals, and soluble in water and in alcohol of 60 per cent. When it is carefully heated, it fuses in its water of crystallisation; and when the heat is increased, it burns off, leaving carbonate of potassa. The aqueous solution of this salt gives no precipitate with chloride of barium, and with neutral or basic acetate of lead; with nitrate of silver it yields a white precipitate, insoluble in acetic, but soluble in nitric acid. The carlinic acid is separated from any concentrated aqueous solution of a carlinate, by means of a slight excess of tartaric acid. Alcohol is added in excess, the fluid filtered, and next evaporated upon a water-bath to dryness, and taken up with ether, from which the acid separates, on evaporation, in a crystalline shape. The acid is very soluble in water, alcohol, and ether, and is naturally met with in the roots of the *Carlina gummifera*, L.

Best Method of Preparation of Emetics.—M. Fleury.—This is a short memoir, not as would be inferred from its title, on the preparation of the potassio tartrate of antimony, but on the preparation of a series of double salts of tartaric acid and bismuth with lime, baryta, magnesia, protoxide of manganese, oxides of copper and zinc; of tartaric acid with chromium, lime, and baryta, and similar salts of iron. The author promises to give, in a future paper, the mode of preparation and analysis of all these salts.

On Chloral.—M. Poggiale.—The contents of this paper are superseded by the paper on this subject abstracted by us from the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 16, 1869.

Camphor Water.—M. Jeannel.—The question of the solubility of camphor in water has been often discussed. According to the author, an alcoholic solution of camphor was made containing 0·375 grm. per c.c.; and a litre of water at 15° does not dissolve more than 0·75 grm. of camphor from this solution after twenty-four hours' contact and frequent shaking. The author states that alcohol does not increase perceptibly the solubility of camphor in water; alcohol at 20° only dissolves 2·437 grms. of camphor, and at 35°, 6 grms. of that substance per litre of alcohol.

Explosion Caused by the Incautious Making-Up of a Medicinal Prescription.—M. Vigla.—The following prescription was handed to a pharmaceutist:—Chlorate of potassa, 8; hypophosphite of soda, 4; simple syrup, 62; water, 125. The operator put the dry salts in a mortar, and commenced rubbing them vigorously, when a most violent explosion ensued, whereby the mortar was smashed to atoms and the operator seriously wounded. The proper course would have been to dissolve each of the salts separately in water.

Moniteur Scientifique, December 1, 1869.

This number contains the following original papers:—

The Physical Phenomena Manifested by Living Organised Beings.—M. Gavarret.—In a lengthy paper, the author discusses and explains the physico-chemical phenomena of life, as far as this is possible. The paper is recommended to the attention of all who study biology.

Artificial Alizarine made by MM. Meister, Lucius, and Co., at Hoechst.—M. Kopp.—Since this subject is, in a scientific as well as industrial point of view, of great importance, we abstract this paper, notwithstanding the same subject has been lately treated by Dr. Bolley. M. Kopp received, from the well-known chemist, M. C. Kœchlin, a quantity of 250 grms. of this artificial alizarine, in the shape of a paste, containing only 7 per cent of dry substance, ash inclusive. The author states that this substance produces a most brilliant and very fast Turkey red. The artificial alizarine was dissolved in a weak aqueous solution of carbonate of soda, filtered and precipitated by means of pure HCl, and the precipitate collected on a filter until the filtrate was quite neutral; the material, thus purified, was used for the purpose of comparison with pure alizarine as obtained from madder. Equal quantities of each of these two substances were dissolved in a weak solution of caustic soda, and with these solutions the following tests were made:—Artificial alizarine $+Na_2O+Cl_2Ba$: violet-blue precipitate, supernatant liquid somewhat faintly rose-coloured; natural alizarine, and the same reagents; also a violet-blue precipitate, supernatant liquid faintly yellowish-rose coloured. Artificial alizarine $+Na_2O+ClCa$: a violet precipitate, supernatant liquid wine-red coloured; natural alizarine, and ditto reagents, ditto precipitate, supernatant liquid wine-red coloured, but less deeply. Other reactions were instituted, all leading to the manifest conclusion that there is no essential difference between this artificial alizarine and natural alizarine. The author records, at length, his experiments with this artificial alizarine, and the action of nitric acid upon this substance, the result of which is that the substance in question gives rise, not only to the formation of phthalic acid, but also nitro-picric acid. When this dried artificial alizarine is treated, at between 150° and 170°, with boiling petroleum oil, a large proportion of the colouring matter is dissolved, and, on cooling, deposited from the oil in needle-shaped crystals. Dr. Quesneville, the editor of the periodical above quoted, adds to M. Kopp's paper a letter received by him, the main purport of which is that MM. Græbe and Liebermann, at Berlin, have been having, with the firm of Meister, Lucius, and Co., a lengthy correspondence, and have been treating with them for the carrying out of their invention on the large scale. These negotiations do not appear to have been successful; and the head of the firm at Manheim, which now carries on the working of the patent of MM. Græbe and Liebermann, happening to be at Berlin while the negotiations with the firm at Hoechst were still pending, accepted the terms made by MM. Græbe and Liebermann; and there is reason to suppose—and this supposition is strongly cofirmed by the researches made by MM. Kœchlin, Bolley, Alfraise, and Kopp, on the artificial alizarine made at Hoechst—that that substance is, in reality, obtained by the process discovered by MM. Græbe and Liebermann, and not, as it is made to appear, by a peculiar process the invention of the manufacturers.

On Ipecacuanha and Emetine.—M. Lefort.

Use of Alkaline Sulphurets for the Purpose of Bleaching Fibres and Tissues of Vegetable Origin.—M. Tessié du Motay.—The chief point in this paper is that the author supposes that the alternate action of reducing and oxidising substances accelerates the bleaching of hemp, flax, and cotton, and the tissues made thereof, and that the strength of the fibre is less impaired by this process. The substances applied as reducing materials are the sulphides of barium or calcium mixed with some sulphide of sodium, and the oxidising substance is chlorine water.

Revue Hebdomadaire de Chimie, November 25, 1869.

New Kind of Gas Furnace.—MM. Bergé and Delheid.—This furnace, or, better, blast-lamp, is a modification of the Bunsen burners in general use, and differs from the latter in the following particulars:—(1) By the mode of the admission of the air, which is made to come in below the gas, and not on the same level therewith, or above it, as in the ordinary Bunsen burners; (2) by the admission of a larger quantity of air, by making it pass through the entire area of the tube; (3) by the addition of an outer cylinder, placed to prevent the heating of the tube from which the flame issues, by making a current of air pass between the two. From the report of the makers of this apparatus, it appears to be of immense service, especially for fusions of mineral substances requiring a high temperature and long-continued heat.

Mode of Treatment of the Fermented Molasses' Juice in order to Extract therefrom Crude Potassa Salts.—MM. Crespel and Bocquet.—The authors add, to the residue of the distillation of the previously-fermented molasses as obtained from beet-root sugar making, a sufficient quantity of carbonate of baryta to convert the sulphuric acid present therein as sulphates into carbonates, and thus to obtain more carbonate of potassa in the saline residue after calcination. The sulphate of baryta formed hereby is re-converted into carbonate by well-known methods.

Formation of Ellagic Acid by means of Gallic Acid.—M. Lowe.—When an aqueous solution of two equivalents of gallic acid and one equivalent of arsenious acid is boiled for several hours, a crystalline precipitate is formed, which is ellagic acid. When it is desired to prepare the latter in quantity, the mixture of the two substances alluded to is made in the proportions mentioned, and, after having been boiled and evaporated to dryness at 120°, is exhausted with alcohol at 90 per cent, wherein the ellagic acid only is soluble.

December 2, 1869.

Salts of Uranium and Cobalt.—M. Selhorst states that, notwithstanding some assertions made to the contrary, the solutions of salts of uranium and cobalt are not fluorescent in Geissler's tubes.

Chemical Method of Purifying Tissues made of Animal Fibres.—MM. Bang and Monestier.—The authors state that woollen and silken tissues are purified from vegetable fibres accidentally mixed up therewith, by steeping the tissues in a mixture of equal parts of water and strong sulphuric acid at 90° temperature, followed immediately by a very efficient washing in plenty of cold water, best a running stream.

Bleaching Wool and Silk.—M. Frézon.—The author proposes to substitute, for the ordinary sulphuring, as it is termed, the use of a mixture of equal parts, by weight, of oxalic acid and common salt, of each 2 kilos., upon 1000 litres of water. The tissues, or yarn, to be bleached is left in this bath for one hour, and next washed in plenty of fresh water.

Boiling-Point of some Concentrated Solutions of Salts.—M. Legrand.—Upon 100 parts of water, each of the following substances, in the quantities quoted, yields a solution, the boiling-point of which is expressed in °C.:—61·5 of chlorate of potassa, 104·2°; 60·1 of chloride of barium, 104·4°; 48·5 of carbonate of soda, 104·63°; 112·6 of phosphate of soda, 106·6°; 59·4 of chloride of potassium, 108·3°; 41·2 of chloride of sodium, 108·4°; 88·9 of chloride of ammonium, 114·2°; 296·2 of neutral tartrate of potassa, 114·67°; 335·1 of nitrate of potassa, 115·9°; 117·5 of chloride of strontium, 117·85°; 224·8 of nitrate of soda, 121·0°; 209·0 of acetate of soda, 124·37°; 205·0 of carbonate of potassa, 135°; 362·2 of nitrate of lime, 151°; 798·2 of acetate of potassa, 169°; 323 of chloride of calcium, 179·5°; an unlimited quantity of nitrate of ammonia, 180°. All the salts to be applied in dry state.

The Journal of the Franklin Institute, October, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Various Processes for Preserving Timber.—Dr. Ott.—From this paper, the second portion of a lengthy memoir on this subject, we learn that the opinion that carbolic acid, and substances containing it, or supposed to contain it, are effectual in preserving timber, is erroneous. The real preservative action of the tar-oils are due, according to this author, to a greenish fluorescent oil that comes over at the last stage of the distillation. Direct trials with pyren and paranaphthaline do not yield successful results. The question whether tar (coal-tar) does contain a sufficient quantity of the fluorescent greenish oil just alluded to, so as to justify the use of coal-tar for preservative purposes, is answered in the negative. The decay of timber, or peculiar transformation which makes it unfit for practical purposes, seems to be, in most instances, produced by the attack of fungi and lichens. The mouldering of wood is distinct from decay, it being merely a chemical process caused by the action of water with small access of air. None of the processes invented to preserve timber by chemicals are perfect; the most simple and practical method is the old, but, unfortunately, far too slow, plan of properly subjecting timber to the action of air and water, as practised in ship-building yards.

This number is almost entirely filled with various valuable papers on the late solar eclipse.

American Journal of Pharmacy, November, 1869.

This number contains the following matter more particularly relating to chemistry:—

Prevention of the Bumping of Liquids.—M. Schumann.—After briefly referring to the several suggestions made for this purpose, and, among these, in particular to Dr. H. Müller's process, the author says—In distilling acids and other liquids, I proceed in the following manner:—The end of an ordinary glass pipe, of about ¼ of an inch opening, is shut at one end, and this end bent into a little hook; the glass pipe is then cut exactly so long as to reach from the bottom of a glass retort to within ¼ or 1 inch of the stopper of the tubulus. By

means of the hook and a piece of twine, or a little hook of thin wire, this glass pipe is placed into the retort, the open end at the bottom, and the retort can be filled, or the retort is filled first and the glass pipe entered afterwards. If the liquid is warmed, the air in the glass tube is expanded, and constantly bubbles out at the open end; and if the boiling-point is reached, vapours of the tension of the atmosphere are formed at the spot where the glass pipe stands on the bottom of the retort, and the boiling continues regularly and quietly.

New Properties and Uses of Naphthaline.—Dr. Ott.—After relating the manufacture of this substance, the author says—Pure naphthaline, as now met in the trade, is similar to alabaster, cracks easily in the warm hands, and becomes negatively electric on being rubbed with silk. Its sp. gr. at 66° F. is 1·15173, melts at 174° F., and boils at 452° F. Molten naphthaline absorbs a large quantity of air, which is given off again on cooling; according to M. Vohl, this gas is pure oxygen. Molten naphthaline dissolves indigo with great facility, forming a dark blue violet liquid, from which the indigo separates on cooling, forming fine shining needles like copper. The amorphous sulphides of arsenic, tin, and antimony are also readily dissolved, and likewise phosphorus, sulphur, iodine, the iodide and chloride of mercury, arsenious, succinic, benzoic, and oxalic acids. Naphthaline can be converted into naphthalic, or phthalic acid, and this latter into benzoic acid, and that, in its turn, into benzol. Naphthaline, $C_{20}H_8$; phthalic acid, $C_{16}H_4O_8$; benzoic acid, $C_{14}H_6O_4$; benzol, $C_{12}H_6$. For the conversion of naphthaline into phthalic acid, 12 parts of pure naphthaline are dissolved in 90 parts of concentrated sulphuric acid, and, next, 80 parts of best finely-powdered peroxide of manganese are added. After the reaction is complete, the product is boiled in five times its own bulk of water, until no more carbonic acid gas is given off; the fluid is next diluted with water, filtered, and evaporated. The conversion of the phthalic acid into benzoate of lime, at a temperature of from 625° to 660 F., is performed in vacuum, but requires considerable skill and practice; an excess of lime is required.

NOTES AND QUERIES.

Testing Lemon-Juice.—"A. S." is referred to O'Neill's "Chemistry of Calico Printing and Dyeing, &c.," page 140 and following pages.

Glue and Gelatine.—(Reply to "G. G.")—See "Knapp's Technology," English edition, by Dr. Richardson and Mr. Watts; see Wagner's "Hand und Lehrbuch der Technologie," vol. v., p. 80 and following pages.

Mellite or Honeystone is a rather rare mineral, consisting of mellitic acid, alumina, and water; its colour is honey-yellow; it occurs in brown coal in Thuringia, near Bilin, Bohemia, and in a few other localities.

Utilisation of Sulphat e of Lime.—(Reply to "Glauber.")—Sulphate of lime, whether it be precipitated, or the native sulphate ground into powder, is useful as a manure by itself. If the article you allude to is very white and pure, it may find a sale among paper makers.

Bronze for Leather.—(Reply to "A Constant Reader.")—It would be impossible to give you the composition of such a substance as you allude to without actually testing the material; but it is very likely that the substance used is a strong alcoholic solution of aniline purple, which is applied for bronzing purposes.

Acacia Charcoal.—(Reply to R. Trevor Clarke.)—This is probably inferior to willow charcoal; the latter makes a very soft smooth powder, and mixes readily with water. The wholesale price varies from 1s. 4d. to 1s. 6d. per lb. Logwood charcoal has been sold under the name of "the immortal carbon."—G. A. K.

Acacia Charcoal.—(Reply to R. Trevor Clarke.)—You are quite correct as to your surmise concerning acacia charcoal; refer to Pereira's "Materia Medica," 4th edition, vol. i., page 320 and following. Wood charcoal obtained from the lime, or linden tree, *Tilia Europea*, L., is officinal in some Pharmacopœias. The cause you suggest of the failure of the use of flowers of sulphur is, we think, wrong; the reason is that, unless flowers of sulphur have been washed, they always contain sulphuric acid. Roll sulphur only is used in the powder manufacture for the same reason.

Analysis of Nitrous Oxide.—Happening to meet with a copy of Roscoe's "Elementary Chemistry," and looking over the article "Nitrous Oxide," I find he asserts that, after analysis of the gas by potassium in a bent tube over mercury, the products, after combustion of the metal in the gas, are nitrogen and potassium hydroxide, KHO! Where does the H come out of? will Professor Roscoe kindly explain this?—VERITAS, Liverpool.

Specific Gravity.—Would you kindly favour me with an answer to the following question:—I read of solutions as being of sp. gr. 1·053, &c. Now what is the rule for determining these strengths by Twaddle's hydrometer; or, in other words, how may I know the rule for calculating these strengths, that when I see the sp. gr. I may calculate them, so as to be able to know at what number of degrees is equal on Twaddle's? I should be glad if you would enlighten me on this point. —CHAS. H. PARKIN.

Electro-Deposition of Copper upon Cast-Iron.—In attempting the above, the writer finds great difficulty in obtaining adhesion between the copper and the rough surface of the cast-iron, previously cleansed by dilute sulphuric acid. Whether the deposit be made slowly or quickly, it is soon separated from the iron by a black powder, which appears to consist chiefly of carbon, silica, &c. Information, or reference to treatises, will be much esteemed by HISTRIX.

Treatment of Oils for Machinery Purposes.—Can any of your readers supply any information upon the process of refining animal and vegetable oils, having special regard to the abstracting the gummy or albuminous matter, without introducing any acids that would be injurious to the machinery afterwards; or perhaps they could recommend some work which treats upon the subject.—B. S.

Gas and Oil Furnaces.—"J. C.," who enquires about gas and oil furnaces, in the CHEMICAL NEWS of September 24th and December 3rd, will find the coke produced in distilling crude anthracene and coal-tar grease from asphaltum to yield him the intense heat he requires, practically free from sulphur and deposit. It could be used in the Siemens regenerative furnace or otherwise.—WM. SCHOFIELD.

MEETINGS FOR THE WEEK.

MONDAY, Dec. 20th.—Medical, 8.

—— Society of Arts, 8. J. Norman Lockyer, F.R.S., "The Spectroscope and its Applications."

—— London Institution, 4. Prof. Guthrie, "Elementary Physics."

WEDNESDAY, 22nd.—Society of Arts, 8. Dr. J. L. W. Thudicum, "On Wines—Their Origin, Nature, Analysis, and Uses; with Special Reference to a New Alcoholic Drink Made from Tea."

—— Geological, 8. 1. Ralph Tate, F.G.S., and J. S. Holden, M.D., F.G.S., "On the Iron-Ores Associated with the Basalts of the North-East of Ireland."
2. J. W. Hulke, F.R.S., "Note on the Skull of the Large Kimmeridge Crocodilian, *Dakosaurus maximus*, Quenstedt, *Steneosaurus*, Geoffr. St. Hilaire."
3. J. W. Hulke, F.R.S. "Note on a Fragment of a Jaw with Peculiar Teeth, from Kimmeridge Bay."
4. Principal Dawson, F.R.S., of Montreal. "Notes on the Structure of *Sigillaria*."
5. Principal Dawson, F.R.S. "Notes on some New Animal Remains from the Carboniferous and Devonian of Canada."

TO CORRESPONDENTS.

CORRIGENDUM.—In Mr. Tomlinson's paper, page 278, column 2, line 27 from bottom, *for* "a small portion of a salt, soluble in water," *read* "a small portion of a salt, *such as soda*, soluble in water."

Analyst.—Chevreul's work, "On Fats," is very rare; it was published about the year 1828.

Alfred Bird.—Received, with thanks.

A Three Years' Subscriber.—You cannot make an extra strong boiled oil; but the older the oil before it is boiled the better for your purpose.

D. F.—A book treating, among other subjects, on Bleaching of Linen, by the Editor of this paper, is in the press, and will shortly be issued.

BOOKS RECEIVED.

A Manual of Diet for the Invalid and Dyspeptic, with a Few Hints on Nursing. By Duncan Turner. London: Churchill.

A Treatise on Asiatic Cholera. By C. Macnamara. London: Churchill.

Professor Tennant, F.G.S., will deliver a Course of Lectures on MINERALOGY applied to GEOLOGY and the ARTS, at King's College, London, on Wednesday and Friday mornings, at nine o'clock, during October, November, and December, commencing October 8th. Fee, £2 2s.

A Course of Lectures on MINERALOGY and GEOLOGY will also be delivered, on Thursday evenings, at eight o'clock. These begin October 14th, and will be continued to Easter, 1870. Fee, £1 11s. 6d. Professor Tennant gives PRIVATE INSTRUCTION in Mineralogy and Geology, Illustrated by a large number of Specimens, at his Residence, 149, Strand, W.C.

The Mysteries of Udolpho.—Astounding Effects!! Innumerable Ghosts appear and disappear!! Three emanate from One!! The Scenes by Fid. Beetles crawl the Dungeon.—Occasionally, AMSTERDAM and its EXHIBITION, visited by Professor Pepper.—PECULIAR PEOPLE OF THE PERIOD, By Messrs. Wardroper.—ACCREDITED RELICS of the late MAXIMILIAN.—The GREAT LIGHTNING NDUCTORIUM is being increased in power: the wonder of the age and science.—THE MYSTERIOUS HAND.—PETIT CONCERT, introducing Herr Angyalphi, the justly renowned Basso Profundo, the Misses Campbell, and Herr Schalkenbach on the Electric Organ. —ROYAL POLYTECHNIC.—One Shilling.

THE CHEMICAL NEWS.

Vol. XX. No. 526.

ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 293.)

In the modes of illumination hitherto described, the light has been made use of in exactly the same condition in which it was received from its source, whether from the sun or a lamp. All that instruments have been required to do has been either to alter its direction or, by concentration, to increase its intensity. It is now proposed to explain a method of conducting microscopical investigations in which the properties of the light have undergone such changes as to produce effects totally different from those of ordinary illumination, and with the result of giving greater insight into the nature of certain structures than could be obtained by other means. The light, in the condition now to be described, is commonly known as *Polarised light*.

With a view to simplify the matter contained in the foregoing papers, no more has been said about the nature and properties of light than was absolutely necessary to enable the action of the apparatus described from time to time to be tolerably well understood. And, although, in the present chapter, far more notice must be taken of the subject, it is by no means intended to give an exhaustive account of the phenomena of polarised light. Space can only be afforded for such an outline as will enable the student to use his apparatus, and observe intelligently. For details, reference must be made to works treating more fully on the subject—such as the chapters on Optics in Mr. Brooke's "Manual of Natural Philosophy," and the various authorities there referred to.

Light, in common with the other forces of nature—heat, electricity in its various forms, dynamic force, &c.,—proceeds from its source in a series of undulations or waves, which may be illustrated in a rough manner by throwing a stone into a pond, when the waves will be seen to spread themselves concentrically from the source of motion.

For convenience of explanation, a ray of light in its ordinary condition may be represented in ideal section by a circle (Fig. 33, 1), and undulations supposed to take place in two planes at right angles to each other (C, D and N, S). By means presently to be described, these two sets of waves can be separated, as at 2, C, D and 3, N, S. The ray of light, instead of having the same properties on every side, will be found to have acquired some qualities peculiar to the state in which it now is, and which may be named the properties of sides. For instance, 2 will exhibit certain phenomena in the direction C, D which do not exist when it is examined in other directions. The same is the case with the other half of the ray (3), which exhibits similar phenomena in the direction N, S. As these properties somewhat resembled those of the poles of a magnet, the term *polarised light* was used to distinguish light so modified, and, although perhaps not the best name that could have been given, has still been retained.

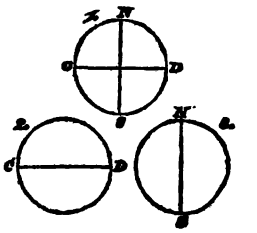
As the phenomena of interference will be frequently mentioned, it will be desirable to state what they are. The sensation affecting the optic nerve which is known as light is caused by the undulations before spoken of—light being represented by motion, darkness by rest.

Should two waves start together from the same place, they would increase each other's intensity; the result would be a wave of double height—a matter easy of comprehension, if water be considered as the medium; with the waves of air producing sound, the result would be a louder sound; and, with light, an illumination of double intensity. Should, however, one wave start before the other by the length of half a wave, the effect would be that the crest of one wave would occupy the position of the hollow of the other, and so fill it up, producing a dead level. The result would be, with water, calm; with air, silence; with light, darkness.

This is known to be the case, in some instances, where the streams from two channels meet in the manner just mentioned: perfectly smooth water is produced, although, before meeting, the surface of both may be violently agitated.

Should the waves of light start at an interval of less than half a wave, they will, by interference, be

Fig. 33*.



broken up into smaller waves, the magnitude of which depends upon the distance one wave has had the start of the other. These small waves produce coloured light, the red wave being the longest, and the violet the shortest. Mr. Woodward gives the following as the lengths of the waves of the various coloured rays of the spectrum:—Red, 266; orange, 240; yellow, 227; green, 211; blue, 196; indigo, 185; violet, 167. The figures represent the numerators of fractions, having as a common denominator the ten-millionth of an inch.

These coloured waves may be produced in various ways; for instance, by very thin plates of transparent substances, such as mica, films of oil or varnish floating on water, and films of air enclosed between transparent solid surfaces, which, by causing a slight difference in the distance of the starting points of the two series of waves of white light reflected from the upper and lower surfaces of the film, sets up interference, and breaks up the waves of white light into smaller coloured ones. The films of varnish were very ingeniously taken up from the surface of water on enamelled cards, by Mr. De la Rue, giving them a beautiful iridescent appearance. Other examples may be found in the feathers of certain birds, as humming birds, peacocks, &c., which possess a metallic lustre produced in the same manner. A minutely grooved surface will also

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

* Brooke's "Natural Philosophy," published by Churchill.

produce similar effects; for example, mother-of-pearl, which consists of a series of thin plates of shell, separated by folds of membrane, producing a grooved structure; also in the finely-ruled gold ornaments known as "Barton's buttons," and the minute specimens of ruling on glass by Nobert, all of which produce brilliant metallic tints by the interference of the two waves reflected, one from the surface, and the other from the bottom of the groove.

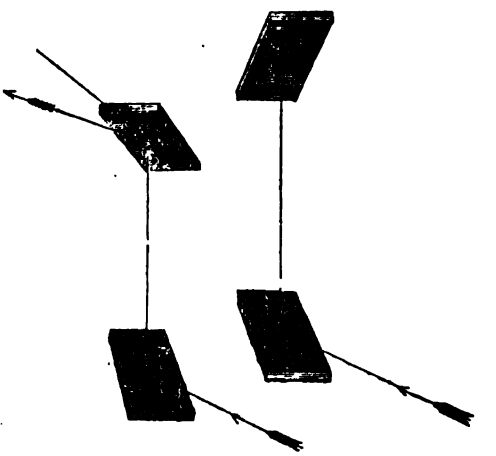
If a convex lens of extremely shallow curvature be placed upon a plane glass surface, and an arrangement be provided for exercising delicate and uniform compression, a series of circular concentric coloured bands will be seen; these are known as "Newton's rings," and are caused, as before, by the interference of the reflections from the film of air contained between the lenses; and as, from the curvature of the lens, the film is of a thickness increasing from the centre to the circumference, a variety of tints are formed at every change of thickness, the rings consisting alternately of groups of colour and dark bands, the latter being the places where total interference takes place, and darkness or rest is the consequence. These dark spaces are much better seen when the apparatus is viewed by a monochromatic light, such as that produced by the flame of a large spirit-lamp the wick of which has been sprinkled with common table-salt. Not only will the dark bands be sharper and more intense, but they will also be considerably increased in number. These rings may often be seen when plane glass surfaces are unequally compressed; for example, a piece of thin cover-glass pressed on a slide with a stick, and sometimes between the thick plate and glass negative in a photographic printing frame.

The undulatory motion of light would seem to be expressed with considerable clearness in the first chapter of Genesis when read in the original Hebrew, which, in common with the other languages of the same family, is remarkable for the numerous inflexions of its verb, which gives it a delicacy and precision of expression unattainable in Western languages. The first verse concludes:—"And the Spirit of God *moved* upon the face of the waters." This sentence immediately precedes the command that light, which may here be taken in its largest sense, including electricity and the other forces, should exist. The Hebrew word translated "moved" is more accurately expressed by *fluttered*; the same inflexion of the verb is used in this sense in the only other place in which it occurs, viz., Deuteronomy xxxii., 11., where it refers to the fluttering of an eagle over its nest. It is certainly a very remarkable expression, and the author believes that its bearing on the subject of light has hitherto escaped notice. The view that the word "light" includes the other forces, and which we have every reason to believe are but different manifestations of them, is supported by the fact, that sources of light proper or luminaries are not mentioned until the fourteenth verse, while the atmosphere or "firmament" of the English version, land, and water, and vegetable life, were all in existence, and under the influence of these mysterious powers of nature, respecting which the undiscovered and unknown probably far exceeds the little that science has at present made us acquainted with.

Light may be polarised in several ways. If a ray of light falls upon glass at an angle of 56° 45', one-half (Fig. 34) will be transmitted, the other half reflected; and, if, instead of a single plate, about ten sheets of thin window-glass be employed, the result will be much more perfect. The reflection, whether one or more plates be used, will be much improved by either coating the back with black-varnish, or placing in contact with it a piece of black cloth or velvet, which will absorb the transmitted portion of the ray. If the light so reflected be examined by another glass mirror, placed at the same angle, and so mounted that it can be moved horizontally in a circular direction, it will be found that, in some positions, the light will be reflected, while, at others, it will pass through, or be absorbed if the back is blackened. These intervals of reflection and transmission occur alternately at every quarter revolution of the upper mirror or analyser, corresponding with the points in Fig. 33, I, marked C, D and N, S.

If a ray of light be passed through a crystal of Iceland spar, one portion will be refracted according

Fig. 34.



to the usual law;* the other half will be refracted in a different direction. And, if these two rays of light be examined with an analyser, they will be found, as in the case of the reflected light, to have acquired the property of sides, or to be polarised. The ray refracted in the common way is known as the ordinary ray. The other, which is polarised in a plane at right angles to it, is termed the extraordinary ray. If a crystal of Iceland spar be placed on a sheet of paper having a black spot on it, the double refraction will cause the formation of two images of the spot or other device drawn on the paper.

(To be continued.)

ON THE

ESTIMATION OF PEROXIDE OF MANGANESE IN MANGANESE ORES.

By E. SHERER and G. RUMPF.

The method of Fresenius and Will for the estimation of manganese, to which for so long preference has been given, has recently been objected to in England by the consumers of the ore. Attention has been called to the fact that this method shows, indeed, correctly the proportion of binoxide of manganese in the sample, but, on the other hand, does not represent its value as an agent for the production of chlorine.

* Chemical News, vol. xx., p. 145.

The reason for this is that metallic iron or its proto-compounds, which are often present in the ore, absorb oxygen to form a sesqui salt when the sample is treated with hydrochloric acid, but remain unchanged when it is treated with concentrated sulphuric acid and oxalate of soda.

In consequence of this, the method of Fresenius and Will is still used in some laboratories, while, in others, it has been superseded by the iron method; from which circumstance an uncertainty in the valuation of the article arises, disagreeable alike to purchasers and sellers.

This has led us to subject the various methods to a careful examination and comparison one with another. Our object was to ascertain, by a series of experiments, how far the estimations by the same method agreed one with another, and then to discover the causes of the differences that have been observed between the results obtained by the different methods.

A sample of American manganese was used for our experiments. A large quantity was pounded, well mixed, and carefully dried at 100° C. The moisture amounted to 0·749 per cent. Quantities of the dry manganese were then at once weighed off for the various tests.

I. *According to the Method of Fresenius and Will.*

Years of experience having proved to us the constancy of results obtained by this method, we considered that three trials would be sufficient. These served to show the actual amount of binoxide in the sample.

1. 2·1098 grms. manganese caused the evolution of 1·355 grms. carbonic acid = 63·49 per cent.

2. 1·5103 grms. manganese caused the evolution of 0·970 grms. carbonic acid = 63·49 per cent.

3. 1·3645 grms. manganese caused the evolution of 0·8770 grms. carbonic acid = 63·53 per cent.

II. *According to the Iron Method.*

The estimations by this process were conducted in the following manner:—

A weighed quantity of pianoforte-wire was dissolved in hydrochloric acid, in a glass flask. Carbonic acid was conducted into the flask during the operation, to prevent the oxidation of the protochloride of iron produced by oxygen from the atmosphere. When complete solution had taken place, a small tube, containing an accurately-weighed quantity of the manganese, was dropped into the flask, the mixture boiled until complete decomposition had taken place, and then cooled in the stream of carbonic acid. The excess of the protochloride was then estimated in the usual way, by means of a standard solution of bichromate of potash. The weight of the iron wire, multiplied by 0·997, was taken as the amount of pure iron used.

1. 0·8748 grms. manganese 1·0796 „ pure iron	Chromate of potash used 22·7 c.c. = 62·00 per cent.
2. 0·7504 „ manganese 1·03668 „ pure iron	Chromate of potash used, 25·85 c.c. = 62·35 per cent.
3. 0·8746 „ manganese 1·1686 „ pure iron	Chromate of potash used, 27·65 c.c. = 62·54 per cent.
4. 0·7604 „ manganese 0·9692 „ pure iron	Chromate of potash used, 21·45 c.c. = 62·20 per cent.
5. 0·9312 „ manganese 1·3846 „ pure iron	Chromate of potash used, 38·2 c.c. = 61·97 per cent.
6. 0·5467 „ manganese 1·2183 „ pure iron	Chromate of potash used, 46·8 c.c. = 61·39 per cent.
7. 1·135 „ manganese 1·0787 „ pure iron	Chromate of potash used, 10·2 c.c. = 62·07 per cent.
8. 1·0446 „ manganese 1·0792 „ pure iron	Chromate of potash used, 14·6 c.c. = 62·01 per cent.

We therefore conclude, from these figures, that this method, proceeded with in the way we have described, does not yield accurate results.

III. *The Estimation of Manganese by the Formation of Chloride of Lime.*

The advantage that this method would seem to have over all others is that the manganese is treated in precisely the same manner in the laboratory as it is on the large scale in the manufacture of bleaching-powder.

Weighed quantities of the sample were treated with strong hydrochloric acid in a small flask until complete decomposition had taken place. The chlorine produced was conducted first into another flask, and then into a U-tube, both of which were filled with a weak milk of lime. The resulting chloride of lime was then tested by Gay Lussac's method, with arsenious acid.

	AsO_3. c.c.	per cent.
(1). 1·0561 grms. manganese	53·90	= 62·60
(2). 1·0845 „ „	56·05	= 63·39
(3). 1·2045 „ „	61·70	= 62·83
(4). 0·4222 „ „	20·70	= 60·14
(5). 0·8102 „ „	39·75	= 60·18
(6). 0·4929 „ „	23·15	= 59·06
(7). 0·4875 „ „	23·15	= 58·15

These figures sufficiently prove that no accurate results are to be obtained by this method.

We next experimented on Bunsen's method.

Weighed quantities of manganese were dissolved in hydrochloric acid in the same manner as in the preceding. The escaping chlorine was received in a strong solution of iodide of potassium, and the liberated iodine subsequently estimated by means of a standard solution of hyposulphite of soda and a solution of starch. To prevent the solution of iodide of potassium from being sucked back into the generating-flask, a few small pieces of magnesite were introduced with the manganese, so that a continual slight escape of carbonic acid took place through the solution.

The solution of hyposulphite of soda was proved by means of a carefully-prepared pure iodine. 3·0436 grms. were dissolved in iodide of potassium, and diluted to 250 c.c. 10 c.c. of this solution required 17·90 c.c. of the hyposulphite of soda solution. 1000 c.c. of hyposulphite of soda solution would, therefore, correspond to 2·3294 grms. of binoxide of manganese. A second trial, in which 2·4767 grms. of the pure iodine were used, 1000 c.c. of the hyposulphite were found to correspond to 2·3319 grs. of binoxide of manganese, which two results closely agree. In testing the manganese—

	NaO,S_2O_2. c.c.	per cent.
(1). 0·6472 grs. manganese	35·8	= 62·76
(2). 0·6427 „ „	34·6	= 62·73
(3). 0·6035 „ „	32·5	= 62·73

These results agreed so closely that we considered further estimations by this method to be quite unnecessary.

If we now compare the various results, we see that the sample, according to the method of—

	Average. per cent.	Greatest difference. per cent.
Fresenius and Will showed	63·50	.. 0·04
Iron method showed	62·06	.. 1·15
Chloride of lime estimation showed	60·90	.. 5·24
Bunsen's method showed	62·74	.. 0·03

From this, we see that only the methods of Fresenius and Will, and that of Bunsen, give constant results; and, of these two, the latter-named undoubtedly represented the value of the ore as an agent for the production of chlorine, since only the chlorine evolved from the sample in the form of gas is estimated. We therefore may conclude that the method of Fresenius and Will gives results too high, while the iron and chloride of lime methods give results much too low. Our next step was to discover the reason for these differences. The cause of the high result obtained by the method of Fresenius and Will has

already been mentioned at the commencent of this paper. We did not consider it necessary to examine whether or no the sample on which we were operating actually contained iron or its proto-compounds. The object we had in view was a purely practical one; and the possibility of the presence of such iron compounds in the ore cannot be disputed. The following experiment proves that a very considerable addition of metallic iron will not in the slighest degree affect the accuracy of the results obtained by this method. 1·4706 grms. of metallic iron were added to 2·4745 grms. of the manganese, concentrated sulphuric acid added, and the test proceeded with as usual. The result obtained—viz., 63·13 per cent—differed only by 0·37 per cent from the average of the three previous trials made by this method, notwithstanding that the amount of iron added was sufficient to render three-quarters of the manganese unavailable as an oxidising agent when dissolved in hydrochloric acid. Since varieties of manganese ore do contain the iron compounds of which we have spoken, we did not further investigate the question whether or no this was the only cause of the two high results which this method yields under certain circumstances. The reason of the uncertainty of the results obtained by the iron method, as, also, of their being generally too low, we discovered to be, that a slight loss of chlorine generally takes place during the operation. When the manganese is added to the protochloride solution, a greater or less quantity frequently floats on the surface of the liquid for a short time. A small quantity of chlorine is evolved from this, which has no opportunity of acting on the iron solution, and is carried off with the stream of carbonic acid. We convinced ourselves that this was the case by conducting the escaping gas into a second flask, which contained a small quantity of weak protochloride of iron solution. As soon as the manganese rose to the surface of the liquid in the decomposing-flask, a yellow colour appeared in the liquid in the second flask, proving that a portion of the chlorine from the manganese escaped into the second flask, and there formed a sesquichloride of iron. The contents of the two flasks were then separately tested with the chromate of potash solution. From the first flask alone, the sample would seem to contain 2 per cent less than it actually does contain.

0·8129 grms. manganese.	
1·06519 grms. pure iron in first flask.	
25·8 c.c. chromate of potash used for first flask	60·48 per cent
0·989 grms. pure iron in second flask	
57·02 c.c. chromate of potash used for second flask	1·99 per cent
	62·47 per cent

This figure agrees tolerably well with the result obtained by Bunsen's method. This method can, therefore, be made to yield accurate results, but only by a difficult and troublesome arrangement, which makes it more complicated and longer than that of Bunsen. Instead of metallic iron, a proto-salt—such as the double sulphate of iron and ammonia—is sometimes used in the iron process, and the decomposition of the manganese effected by means of weak sulphuric acid. No loss of gas probably takes place in this method. Experience has shown us that it is very difficult to obtain such salts perfectly free both from sesqui-compounds of iron and moisture. We did not, therefore, experiment on this method.

The reason of the great irregularity in the results obtained by the chloride of lime method is easily perceived. At 40° C., chloride of lime commences to be decomposed into chlorate of lime; so that a greater or less speed in the evolution of the gas will produce a greater or less warmth in the milk of lime, and, consequently, more or less decompose it. We endeavoured, by external cooling, to prevent this warming and decomposition, but with no satisfactory results, as the following figures will show. The milk of lime was cooled by the external application of a mixture of sulphate of soda and hydrochloric acid.

		AsO_5. c.c.	per cent.
(1).	0·3633 grms. manganese	18·90	= 63·80
(2).	0·7778 ,, ,,	38·45	= 60·64
(3).	0·8185 ,, ,,	40·50	= 60·70
(4).	0·9204 ,, ,,	46·25	= 61·64
(5).	0·6975 ,, ,,	35·65	= 62·69
(6).	0·5581 ,, ,,	26·85	= 59·01

This method can, therefore, only be used for approximate results.

In estimating the manganese by the method of Bunsen, the iodine liberated by the chlorine should be tested as soon as possible after the decomposition. The iodine solution from the tests numbered 1 and 2 were again tested after standing twenty-four hours. The results were both over 65 per cent. This was caused by the conversion of iodine into hydriodic acid. In conclusion, therefore, we may decide that the results obtained by Bunsen's method exceed all others in accuracy. Its simplicity, also, is greater than that of the iron method, as it requires only one weighing, and does not need a stream of carbonic acid. At the mines where tests continually have to be made, the method of Fresenius and Will would certainly appear to be the best and simplest, so much the more that here no accidental admixture of iron can have taken place.

In conclusion, we would suggest that it is more reasonable to represent the value of manganese rather by chlorometrical degrees than by the percentage of binoxide. Neither the method of Bunsen nor the iron method represent the percentage of binoxide, but the relative value of the ore as an agent for the production of chlorine; and, therefore, a similar form of expression for the value of chloride of lime and manganese, seems to us desirable.

Wiesbaden, Oct. 11th, 1869.

PS. The foregoing paper is the result of experiments made at the laboratory of Dr. R. Fresenius, in Wiesbaden.

ON SOME

TECHNICAL APPLICATIONS OF THE SPECTRUM MICROSCOPE.*

By H. C. SORBY, F.R.S., &c.

(Continued from p. 296.)

Adulterations of Wine.

The only cases in which the spectrum method can be easily applied to detect adulterations in wines are when some colouring matter has been introduced to give a false appearance of age, or to bring the colour up to some desired standard. According to Payen's interesting work,† logwood and Brazil wood were at all events employed a few years ago for this purpose; and rhatany root and the berries of the so-called *Virginian Poke* (*Phytolacca decandra*) are sometimes used. I mention these because I purpose to briefly describe how they may be detected, as an illustration of the methods which may be employed in such investigations. I must, however, confess that I have not detected these substances in any wines of commerce that I have yet examined; but then I have had very little opportunity for studying those likely to contain them.

In order to detect logwood or Brazil wood, a small quantity of the wine should be agitated in a test-tube with an equal volume of ether, which rises to the surface in an almost colourless state if the wine be pure, but is tinged with a more or less strong yellow when either of the above-named substances is present. The etherial solution should be transferred to a small evaporating dish by means

* Communicated by the author, having been published in the *Quarterly Journal of Microscopical Science*, vol. ix., new series, p. 358.

† "Précis des Substances Alimentaires," note at p. 455.

of a pipette, and a fresh quantity of ether agitated with the wine, and added to the other. The most useful kind of pipette for this and similar purposes is one with a small vulcanised india-rubber top, so arranged that, after having been compressed, it may, by its own elastic force, draw up the liquid. After evaporating the solution to dryness, a small quantity of the colour should be dissolved in water in an experiment cell, and treated with bicarbonate of ammonia. In both cases this developes a single very distinct absorption band in the green, that characteristic of logwood being situated at 4¾ of my scale, whilst that of Brazil wood is farther from the red end, at 5¼; and the solution is strongly fluorescent, of a peculiar orange colour. These spectra are so characteristic, and can be so easily compared with those of the substances themselves, that an extremely minute quantity of either could be detected with certainty.

The colour of rhatany root does not give any well-marked band in an aqueous solution, either acid or alkaline; but when dissolved in alcohol and slightly acid, it shows a moderately distinct band between the yellow and green, at 3¾ of my scale, and a fainter at 7¼. In order to detect this substance the wine should, therefore, be evaporated to small bulk, and re-dissolved in strong alcohol, and after this has stood in a test-tube until the insoluble matter has been deposited and the solution has become quite clear, the absorption band at 3¾ may be more or less distinctly recognised, according to the amount of the rhatany root present; but the natural colour of the wine makes it impossible to detect a very small quantity.

The dark crimson berries of the Virginian poke are remarkable for containing a colour belonging to my group C; whereas those of nearly all fruits of that tint belong to group B. It shows two absorption bands, which are more distinct in an alcoholic than in an aqueous solution, and are 4¾, 7¾. To detect this substance we ought, therefore, to adopt the same process as in the case of rhatany root, and endeavour to see those bands, which might sometimes be made more distinct by adding a little water and sulphite of soda.

These substances may be changed by keeping long in solution, and therefore might not be detected in old wines.

On the Application of the Spectrum Microscope to the Chemistry of Beer.

In studying the colouring matters in beer, it is, in the first place, desirable to understand those met with in the various substances used in brewing; but it is unnecessary to take into consideration colours insoluble in water.

When malt is digested in hot water, an orange-yellow colouring matter is extracted; but the solution contains so much sugar and gum as to interfere with the necessary experiments. It should, therefore, be evaporated to the consistency of syrup, alcohol added by degrees, and the precipitated gum and sugar well stirred up, so that as much colouring matter as possible may be dissolved. After standing till quite clear, this solution, on evaporation, yields a pale orange-yellow syrup, which, when dissolved in water or alcohol, gives a spectrum without any decided characters. Ammonia makes it a deeper and brighter yellow; and the same change occurs when it is dissolved in sulphuric acid. In all these experiments, a mixture of equal volumes of the concentrated acid and water should be used; for, if much stronger, it chars vegetable substances, and, if weaker, it does not act well with the reagents added to it. When dissolved in this, the colour of malt is made much darker by the addition of nitric acid or chlorate of potash; but an excess of the latter makes it rapidly fade to a pale yellow, whilst hypochlorite of soda, in small quantity, makes it somewhat more orange, and more makes it a very pale yellow. The characteristic test is hypochlorite of soda, added to an aqueous or alcoholic solution in which a little citric acid has been dissolved. The addition of a suitable quantity of the hypochlorite turns the aqueous solution to a pink flesh-colour, becoming deeper; but it is not clear, and, on standing, a copious pink flocculent deposit subsides. When seen to the greatest advantage, the spectrum is 4 . . . 8 . . 10 . . 11—, without any decided narrow absorption bands. If, however, the colour was dissolved in alcohol, the solution remains clear; there is a well-marked band at the yellow end of the green, which at first is 4¾, and, as the colour becomes deeper, is more distinct, and rises to 5. The flesh-coloured deposit from the solution in water is easily dissolved by alcohol, and gives the same spectrum; and these facts are so unique that this colouring matter could be easily recognised in complicated mixtures. It certainly does not occur in barley, and must, therefore, be formed in the process of malting. Water extracts from barley a brown colour, insoluble in alcohol, which exactly corresponds with that of liquorice; and also a yellow colour, soluble in spirit, which does not exactly correspond with that obtained from hops, but yet differs from it in such a manner that, taking all the facts into consideration, it seems probable that it is the same colour in a less pure condition.

When hops are boiled in water, the solution evaporated, and the gum, &c., removed by alcohol, as already described, an orange-yellow colour is obtained which, in general appearance and in its behaviour with most reagents, is extremely similar to that from malt. It may, however, be easily distinguished by the action of hypochlorite of soda; for, when this is added to an aqueous solution previously treated with a little citric acid, it merely changes it to a very pale yellow, without any shade of pink. This colour, or, at least, colours, which I have not been able to distinguish from it, is met with in several kinds of faded leaves, stems, and roots, and seems to be very generally distributed.

When the partially-charred malt used in brewing porter is digested in water, a dark solution is obtained; and, on evaporation to small bulk and treatment with alcohol, nearly the whole of this dark colour is precipitated along with the gum. To obtain it more pure, it may be re-dissolved once or twice in a little water, and re-precipitated by alcohol. When dissolved in water, it gives an orange-brown solution, with a spectrum . . . 4 . . 5 . . 6—, made somewhat darker by ammonia; and, when dissolved in sulphuric acid, the colour and spectrum are nearly the same. Oxidising reagents do not make it any darker in either solvent, but merely cause it to fade to a pale yellow.

Besides this dark colour, highly-dried malt contains an orange-yellow, soluble in both strong alcohol and water. This differs from that obtained from pale malt, in not being turned at all pink by the action of hypochlorite of soda, and is distinguished from the colouring matter of hops or of beer (with which it agrees in general colour) by not being made at all darker by the addition of oxidising reagents to the solution in sulphuric acid, as if it were already in an oxidised condition.

Liquorice is chiefly coloured by a brown substance, which closely resembles that present in dark malt. When alcohol is added to the strong aqueous solution, it is precipitated in the same manner; and when dissolved in water the general colour is very similar, though rather more orange. They may, however, be easily distinguished by the action of oxidising reagents. If to solutions in sulphuric acid of equal depth of colour equal quantities of chlorate of potash be gradually added, the malt first becomes a much paler orange, and then pale yellow; whereas the liquorice turns to an orange, which does not become pale until very much more chlorate has been added than suffices to make the malt very pale. Though they can thus be easily distinguished, yet when mixed together, as in porter, it is not easy to obtain decided results. The change of colour is very similar in kind, and differs only in degree; so that the addition of too much chlorate may make the liquorice as pale an orange as the malt; and

when not much liquorice occurs mixed with malt, it becomes very difficult to recognise it. Still, however, with care its presence may be detected in ordinary porter.

That colouring matter of porter which is soluble in strong alcohol behaves with reagents like a mixture of those from beer and dark malt. Hypochlorite of soda turns the solution in sulphuric acid to a red, but of a less deep tint than in the case of beer.

The sweet wort obtained in brewing contains the colour of malt, already described, and, after boiling with hops, the hop colour; but after fermentation a change is found to have occurred, which proceeds still further when the beer is kept in the barrel. This change is best shown by the addition of hypochlorite of soda to the solution of the colouring matter in sulphuric acid. The gum, &c., should be removed by means of alcohol, in the manner already named when describing malt. Taking two experiment cells, and dissolving in one the colour of the unfermented wort, and in the other an equal quantity of the colour of beer that has been kept some months in barrel, the general tint is seen to be very similar. Since the solutions are otherwise apt to be turbid, it is best to fill the tubes three-fourths with the sulphuric acid diluted with an equal bulk of water, and then to fill up with alcohol, after which the coloured syrup can be added on a platinum wire, and made to dissolve by stirring. On adding little by little hypochlorite of soda to such a solution of the unfermented wort, it first turns it a little more orange, and then pale yellow; whereas, in the case of the beer kept in barrel, it is first gradually changed to a deep pink-red, which, when strong, is 3 - - 4—, and, when seen to the greatest advantage is 5 - - 7½ . . . 9½ - - 10—, having, therefore, a broad absorption band at 6½. On adding more hypochlorite it becomes more orange, and finally an orange-yellow. The fermented wort behaves in an intermediate manner; and hence it should appear that the change begins during fermentation, and is continued when the beer is kept in barrel. Still, however, it does not seem to depend simply on fermentation, since no such change occurs when fermented on a small scale; and, therefore, it may perhaps be due to deoxidisation, which would be more likely to take place in a large quantity less exposed to air.

If in any case it were desirable to ascertain whether or no any mixed liquid contained beer, the various reactions with the reagents already mentioned might enable us to form a very decided opinion when other tests failed; but so much would depend on the circumstances of the case that no general rule could be given.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 16th, 1869.

Dr. A. W. Williamson, F.R.S., &c., President, in the Chair.

The minutes of the previous meeting having been read and confirmed, the following certificates were read:—

For the first time:—Pedlar, Royal College of Chemistry.

For the second time—James Bell, Howell Hill, Ewell; G. R. Hislop, Gas Works, Paisley; William Ladd, Beak Street, Regent Street; Alfred Bird, Worcester Street, Birmingham; H. Seward, 15 Barnsbury Park, N.; Edwin Lepper, 11, Maiden Lane, Queen Street, Cheapside, E.C.

For the third time—Samuel Jefferson, Secretary to the Yorkshire Board of Education, Woodville Terrace, Woodhouse Lane, Leeds; Clements Higgins, Demonstrator of Chemistry, King's College, London; James John Bourey, Analytical Chemist, 10, Stepney Causeway, E.

The last-named gentlemen were ballotted for and duly elected.

Mr. McLeod gave a verbal account of some experiments he had made on the presence of gases in sea water. At the last meeting he had stated from memory that Thames water contained 6 volumes of gas in 100 of water: on referring to his note-book he found that 100 vols. of this water contained—Nitrogen, 1·398; oxygen, 0·619; carbonic anhydride, 4·180; giving a total of 6·197 vols. in 100 vols. of water. He had experimented upon some sea water collected at Worthing, some distance from the outfall of any river, and which had been exposed to the air for twenty-one months, and found that the amount of gas in 100 vols. was—Nitrogen, 1·104; oxygen, 0·572; carbonic anhydride, 2·620; the total being 4·296. This was very much in excess of the quantity found by Mr. Hunter, as recorded in his paper read at the last meeting, but the quantity of carbonic anhydride was much smaller than might have been expected. The hardness of sea water was greater than that of Thames water, and therefore one would expect a larger quantity of anhydride to have been produced by the distillation. He intended, if possible, to collect some water from the surface of the sea, and to ascertain what quantity of gas it contained.

The President, in thanking Mr. McLeod for his communication, said Dr. Hugo Müller had, he thought, made experiments on the condition of carbonic gas when dissolved in water which led to remarkable results.

Dr. Hugo Müller, in experimenting on the manufacture of soda-water in an apparatus which was formerly much used, found that if the carbonic acid remained in contact with the water for twenty or twenty-four hours, it disengaged itself gradually, adhered to the sides of the glass, and appeared altogether different than when it was left only a short time in contact with the water. He had also noticed that, with the addition of a little common salt, the carbonic acid dissolved much quicker, the chloride of sodium being actually decomposed by the carbonic acid, hydrochloric acid and bicarbonate of soda being formed. He had proved the presence of hydrochloric acid, by ultramarine, which was neither acted upon by carbonic acid nor chloride of sodium. Another instance, in which the chloride was decomposed by carbonic acid, was when carbonic acid was passed through a neutral solution of chloride of lead. In a short time, a clear solution was obtained, and, after a certain time, a precipitate consisting of chloro-carbonate was formed.

Dr. Divers observed that, if rectified spirit were mixed with distilled water which contained air through exposure, a kind of effervescence occurred, which he supposed was due to the formation of minute bubbles of air being liberated and rising to the surface. This seemed to show that a mixture of spirit and water had less solubility for air than pure water itself.

The President wondered if the temperature had anything to do with the peculiar state in which Dr. Hugo Müller found the carbonic acid. He had been looking over Dr. Andrews's experiments on the states of carbonic acid at different temperatures, and it would seem that a few degrees of temperature made a great deal of difference in the proportion of the acid, which was not overcome by enormously multiplying the pressure. The observations on the greater solubility of carbonic acid in water containing sodic chloride he thought of great theoretical value, confirmed as they were by the ultramarine test. He (the President) had held, for years, that salts generally dissolved in water by decomposition, and he was interested to find his view confirmed by the introduction of the ultramarine test for the presence of free hydrochloric acid.

After some further remarks from Dr. Hugo Müller, on the chloro-carbonate of lead reaction,

The President alluded to a reaction he had published twenty-four or twenty-five years ago—viz.,

the action of chlorine in water in the presence of salts like sodic sulphate.

The meeting was then adjourned to January 20th, 1870.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

The ordinary meeting of this section was held on the evening of Tuesday last, Dr. Wallace, F.R.S.E., one of the Vice-Presidents, in the chair. Several new Associates were balloted for and admitted. Thereafter,

Mr. W. R. Hutton, manufacturing chemist, read a paper "*On the Chemistry of Coal-Smoke.*" The author glanced at the subject both in its sanitary and its economical aspects; and then, in order that the scientific principles involved in the prevention of smoke, and in the complete utilisation of the heating power of raw coal, might be properly understood, he gave an analysis of best Wishan coal, one of the finest kinds of fuel in Scotland. It was as follows:—

Water	2·8
Sulphur	0·4
Volatile matter	36·9
Fixed carbon	56·3
Ash	3·6
	100·0

Volatile Matter.

Carbon	14·0
Hydrogen	6·0
Oxygen	15·9
Nitrogen	1·0
	36·9

In the ordinary combustion of coal, black smoke, and therefore soot, is only producible from the volatile matter of the coal, the fixed carbon, ash, &c., being incapable of generating smoke. The value of a fuel as a generator of heat is estimated according to the amount of carbon and hydrogen present in it. As ordinarily used, coal, during its combustion, gives rise to many curious compounds, including carbonic oxide, carbonic acid, watery vapour, ammonia, sulphurous and sulphuric acids, and various hydrocarbons, some of the paraffin series, and others of the naphthalin series; and, as they are volatile when liberated, they rise into the atmosphere and form the mixture known as coal-smoke. This material differs in its properties and composition, according to the composition and mode of burning the coal; but, in all cases, sooty carbon and moisture are abundant, the former especially so in black smoke. But black smoke is soot, and is the result of the imperfect combustion of the coal, and even of its wasteful use. Mr. Hutton then went on to examine soot in its chemical aspects, and explained, in detail, how the difference of temperature in a furnace or domestic fire regulates the composition of the volatile matters of soot. The composition of London and Glasgow soot was shown in a table, of which the following is a copy.

Analysis of Soot.

	London.	Glasgow.
Carbon	53·18	35·7
Tar and oil	18·00	15·0
Ammonia	1·75	2·8
Potash	0·20	0·3
Soda	0·34	0·3
Lime	1·00	0·8
Magnesia	0·30	trace
Phosphate of lime and alumina	2·08	3·2
Iron	0·40	0·7
Sulphuric acid	4·60	7·9
Chlorine	trace	0·4
Sulphocyanogen	0·25	none
Carbonic acid	0·70	trace
Sand	14·40	25·7
Water	2·80	7·2
	100·00	100·0

The author said he could guarantee the genuineness of the sample of London soot; but he was afraid that the Glasgow soot which he had examined was adulterated, judging by the large percentage of sand and water contained in it. The large proportion of sulphuric acid might be accounted for by the sulphurous quality of the Scotch coal, and by the great number of chemical works in Glasgow. Genuine Glasgow soot ought to contain a larger amount of ammonia: both samples were distinctly acid. While referring to the various uses of soot, Mr. Hutton mentioned that a considerable quantity was recently shipped to the West Indies, to be used there for the growth of the sugar-cane. The price is from 30s. to 40s. per ton. Considering that soot rarely contains less than about one-sixth of its weight of hydrocarbon compounds, the author of the paper proceeded to look at the production of soot from a commercial point of view, and asked if the value of soot is proportionate to the evils resulting from the production of the material. Not more than 500 tons are gathered in Glasgow per annum, and the value never exceeds £1000. Taking the waste of fuel, the loss of the nitrogen of the coal, the destruction of property, and the personal discomfort resulting from smoke and soot, he found that there was no profit. but rather a great loss instead. As a practical solution of the "smoke nuisance," Mr. Hutton briefly sketched a plan by which practically smokeless fires might be obtained, while all the volatile compounds could be separately collected, and be got in a form fit for utilisation. He would distil the coal before burning, stopping short the process of distillation at such a stage as would permit *soft coke* to be formed—that is, fixed carbon with a sufficient amount of volatile matter in it to render it slightly inflammable. The other useful products would be chiefly crude oil, coal-gas, and ammonia. Assuming, as a basis of calculation, 2000 tons of coal to be used daily, that amount would yield, in round numbers—

Soft coke	1400	tons.
Crude oil	40,000	gallons.
Ammoniacal water	30,000	,,
Coal gas	6,000,000	cubic feet.

Deducting the ash, the fixed carbon would be reduced to 1329 tons. Mr. Hutton calculated that the coke and the other products would realise £742, while the coal (at 5s. per ton) and the labour, &c., would cost £600, leaving an apparent balance of £142, in addition to all the other advantages which would result from the complete combustion of the fuel. The coke would be such a material as would be available alike for domestic fire-places and the furnaces of steam-boilers, &c.

At the conclusion of the paper, various members spoke in commendation of Mr. Hutton's views. In reply to Mr. Stanford,

Mr. Hutton stated that such coke as he had suggested in his paper could be burned in the ordinary grate, without the expense or any other of the inconveniences attending the use of the grate which was devised some years ago by the late Dr. Neil Arnott.

On the motion of the Chairman, a codial vote of thanks was awarded to Mr. Hutton; and the meetings of the Section were adjourned for a month.

The Faraday Memorial.—The subscriptions to the Faraday Monument Fund, received up to Dec. 7, amount to £1400. The object of the fund is to provide a public memorial to Faraday, and the subscription from one person is not to exceed five guineas.—*Nature.*

NOTICES OF BOOKS.

The Life and Letters of Faraday. By Dr. Bence Jones, Secretary of the Royal Institution. London: Longmans, Green, and Co. 1870. 2 vols., 8vo., with illustrations.

II.

The second volume of this work is divided into four chapters, of which the first treats of Faraday's "First Period of Electrical Research," included between the years 1831 and 1840, and extending to his forty-ninth year. The great discoveries of this period of his life were those of magneto-electricity and of definite electrical decomposition, So early as 1831, we find the germ of the idea of "lines of force"—an idea which pervaded all his succeeding philosophy. "By magnetic curves," he writes, "I mean lines of magnetic forces which would be depicted by iron filings." The first series of his "Experimental Researches in Electricity" was the result of ten days' labour, and was read on November 24th, 1831, at the Royal Society. The full course of these researches, together with the dates, has been so carefully noted by Dr. Bence Jones, in the notice of Faraday which appeared in the *Proceedings of the Royal Society* for last year, that it will be needless to enter into any detail here; moreover, the main facts of these great researches are more or less known to all of us, and require but little description. We may mention that the appendix to Chapter 1 contains an example of the notes from which Faraday lectured. On one side of a sheet of paper, he was in the habit of setting down the experiments, numbered and in order, and accompanied by divisions of the lecture-hour into intervals of minutes, varying from five to fifteen; on the other side, the notes of subject-matter were written. with figures corresponding to the numbered experiments.

The second chapter includes the years intervening between 1841 and 1844, and is entitled "Rest between the Periods of his Experimental Researches—Swiss Journal—Nature of Matter." The intense mental labour connected with the electrical researches had brought on attacks of giddiness and loss of memory, and for four years Faraday undertook but one research connected with electricity. He entirely rested during one year, even giving up lecturing at the Royal Institution; and he spent three months of this time in Switzerland. The journal which he kept during this period is full of interest, and shows us the character of the man apart from his science; and it may be here remarked that, although we are apt to study this character more in reference to Faraday's great efforts of scientific thought, it is equally worthy of minute study for other reasons, for the humanity, the gentleness, the love of truth, and the consistency, which were such prominent characteristics of the man.

In 1843, the present Emperor of the French, at that time a prisoner in the Fortress of Ham, addressed several letters to Faraday on scientific subjects. We here find the Emperor appearing in an altogether novel light—viz., as the propounder of a new theory of the action of the voltaic pile, which was read to the Academy by M. Arago, but which does not appear to have been received with much warmth. The Emperor, however, shows that he possessed some knowledge of electricity, and his remarks and inferences are by no means superficial. In some of his experiments he required a galvanometer, but could not succeed in constructing one "parceque les aiguilles aimantées furent toujours déviées par l'attraction des barreaux de fer qui entourent mes fenêtres." Sometimes he seems to have thought of applications of voltaic electricity to purposes of war:—"*What is the most simple* combination," he asks Faraday, "to give to a voltaic battery, in order to produce a spark capable of setting fire to powder under water or under ground?"

The third chapter comprises the period between 1844 and 1855, and extends to Faraday's sixty-fourth year; it discusses "Later Period of Electrical Research—Discovery of the Magnetisation of Light—The Magnetic State of all Matter—Atmospheric Magnetism." The discoveries made during this second period of electrical research were published in the eleven series of "Experimental Researches in Electricity" included between the nineteenth and the thirtieth. Although the discovery of the magnetisation of light (which Sir William Thompson has designated "the greatest discovery of this century)" was among these discoveries, Dr. Bence Jones considers that, "great as these discoveries were, they will not at the present time rank with the three great discoveries of magneto-electricity, voltaic induction, and definite electro-chemical decomposition, which made the glory of the earlier period of the 'Researches in Electricity.'"

Here are some remarks drawn at random from various lectures given at the Royal Institution during the year 1845. Speaking of the fineness of gold wire, he said—"Four sovereigns' weight of pure gold could be drawn into a wire long enough to surround the globe." In a lecture on mercury, he said—"Lecture-room, with all its walls, floors, roofs, &c., from top to bottom, and full of people, if standing in a trough of mercury having the same base as the lecture-room, would only raise a column at the sides 17½ inches high." Of the voltaic battery, he said—"This instrument has done—is doing—more in developing the internal molecular powers of bodies, and the unity of the various forces in nature, than any other offspring of human thought." Speaking of evening lectures at the Royal Institution, he said—"As to popular lectures (which at the same time are to be *respectable* and *sound*), none are more difficult to find. Lectures which *really teach* will never be popular; lectures which are popular will never *really teach*. They know little of the matter who think science is more easily to be taught, or learned than A B C; and yet who ever learned his A B C without pain and trouble?" In a letter published in the *Philosophical Magazine* for 1846, in which we find some of Faraday's boldest and grandest speculations, we have one of the many examples of the singular modesty and humility with which, even at the summit of his fame, he propounds a theory. "I think it likely," he says in concluding, "that I have made many mistakes in the preceding pages, for even to myself my ideas on this point appear only as the shadow of a speculation, or as one of those impressions upon the mind which are allowable for a time as guides to thought and research. He who labours in experimental inquiries knows how numerous these are, and how often their apparent fitness and beauty vanish before the progress and development of real natural truth."

In 1855, Faraday concluded his "Experimental Researches in Electricity." They had extended over a period of twenty-six years, and undoubtedly constitute his greatest and noblest work; the ultimate issue and result of the work it is impossible to estimate, each branch of it as left by him, nay, the smallest twig, may be transplanted, until a very forest is the result. It has stimulated, and will stimulate work; it admits of an infinity of applications; above all, it is a grand example of accurate work, combined with accurate thought, with method, with genius, with a refined manipulation, and a subtle mind. Let us glance at the main results of his electrical researches, in the order in which they occur. "The Induction of Electric Currents—The Evolution of Electricity from Magnetism—Terrestrial Magneto-Electric Induction—Identity of Electricity from Different Sources—Conducting-Power generally—Electro-Chemical Decomposition—Electricity of the Voltaic Pile—Induction of a Current on Itself—Static Induction—Nature of the Electric Force—Character of the Electric Force in the Gymnotus—Source of Power in the Voltaic Pile—The Electricity evolved by the Friction of Steam—The Magnetisation of Light, and the Illumination of Magnetic Lines of Force—New Magnetic Actions—The Magnetic Condition of all Matter—The Crystalline Polarity of Bis-

muth, and its relation to the Magnetic Form of Force—The possible relation of Gravity to Electricity—The Magnetic and Dia-Magnetic Condition of Bodies, including Oxygen and Nitrogen—Atmospheric Magnetism—Lines of Magnetic Force, and the Employment of Induced Magneto-Electric Currents as their Test and Measure—The Constancy of Differential Magne-Crystallic Force in Different Media—The Action of Heat on Magne-Crystals—The Effect of Heat upon the Absolute Magnetic Force of Bodies."

This magnificent work was done under conditions of penury; yet, "during a great part of these twenty-six years, the Royal Institution was kept alive by the lectures which Faraday gave for it." Faraday received, during the greater part of this time £100 a-year from the Institution, and nearly £100 as Fullerian Professor. He kept account of his expenditure in research and apparatus literally to the uttermost farthing. Altogether, Faraday laboured for science for fifty-two years, one-half of which time was devoted to the "Experimental Researches in Electricity."

In June, 1862, Faraday gave his last Friday evening discourse at the Royal Institution. The following are the notes which he made for this his retirement from active duties:—

"Personal explanation,—years of happiness here, but time of retirement; Loss of Memory, and *physical* endurance of the brain.

"1. Causes—*hesitation and uncertainty* of the convictions which the speaker has to urge.

"2. *Inability to draw* upon the mind for the treasures of knowledge it has previously received.

"3. *Dimness*, and forgetfulness of one's former *self-standard*, in respect of *right*, *dignity*, and *self-respect*.

"4. Strong duty of *doing justice to others*, yet inability to do so.

"5. *Retire*."

Who among those present will ever forget the intense enthusiasm which was exhibited at the conclusion of the lecture "On Platinum," nearly the last which Faraday gave? "I have desired to retire," he said, "as I think every man ought to do before his faculties become impaired; but I must confess that the affection which I have for this place is such that I hardly know when the proper time has arrived." No victor in the Olympian games, no conqueror ascending in triumph the Capitoline Hill, no *prima donna* in the height of her fame, ever received a more complete ovation.

"For thirty-eight years," says Dr. Bence Jones, "his lectures were the life of the Royal Institution. His singular power of making himself one with his audience was felt in his Juvenile Lectures, in his Theatre Courses, and in his Friday Evening Addresses." His great success as a lecturer may be attributed to his careful attention to strict rules; some of his earlier remarks on lecturing we gave in the first of these notices, the following rules were found among his notes:—

"Never to repeat a phrase.

"Never to go back to amend.

"If at a loss for a word, not to ch—ch—ch, or eh—eh—eh—, but to stop and wait for it. It soon comes, and the bad habits are broken, and fluency soon acquired.

"Never doubt a correction given to me by another."

In addition to this strict attention to rules, Faraday took lessons in lecturing in 1823, and again in 1825 and 1826, before giving his first course of lectures in the Institution.

Dr. Bence Jones closes his admirable "Life of Faraday," by a statement of the chief of the characteristics of the great philosopher, and of the qualities which combined to render him so noble and so good. "As a philosopher, his first great characteristic was the trust which he put in facts. . . . His second was his imagination. It rose sometimes to divination, or scientific second-sight, and led him to anticipate results that he or others afterwards proved to be true." As a man, his first and greatest quality was his truthfulness; the second, his kindness; the third, his energy. "His religion was a living root of fresh humility, and, from first to last, it may be seen growing with his fame and reaching its height with his glory, and making him, to the end of his life, certainly the humblest, while he was also the most energetic, the truest, and the kindest of experimental philosophers. . . . . His standard of duty was supernatural; it was not founded upon any intuitive ideas of right and wrong; nor was it fashioned upon any outward expediences of time and place; but it was formed entirely on what he held to be the revelation of the will of God in the written Word, and throughout all his life his faith led him to act up to the very letter of it.

Much has been said and written about the Faraday Memorial, and the proposition to erect a monument to him in St. Paul's cathedral is being actively advanced. Looking at his many and great works, and at this last record of him, full of his every-day thoughts and actions, we are tempted to repeat the hackneyed, but here infinitely appropriate, phrase "*Si monumentum requiris, circumspice.*" Of Faraday himself we may truly say, "Exegit monumentum ære perennius." Yet there should be some mark of the popular esteem for such a man—and if it takes the form of a statue, it should be among the quick, not among the dead. It should be in the busy world, and in the light of day, that they who pass by may stay, and read, and remember. Whoever enters St. Paul's, must feel the gloomy chill of the vast, silent edifice; all is dull and gloomy, and the surroundings recall to us obsequies, and friends mourning, and the terrors of death. We would not have the statue of Faraday placed here; we would not wish to think of him with sorrow in our hearts and ashes on our heads; but we would have the memorial in our often view, and unencompassed by aught that brings feelings of gloom and unhappiness, in that we shall see him no more. To one who asked him, during his last years, how he was, he replied "Just waiting." Let us think of the old philosopher as he sat by his window at the close of life looking out upon the green trees and fields of Hampton, and delighting in the beauties of that Nature he had loved so fondly. He who had been so strong, so mighty to prevail, was now as a little child. The *lumen purum* of the great intellect which had penetrated the mysteries of Nature as few had ever done before, was flickering, and faint, and dim. *Nunc dimittis*,—"the sweetest canticle of all when a man hath obtained worthy ends and expectations"—is the thought which fills his mind; and as he gazes into the bright world without, the landscape fades almost imperceptibly from his sight, the voice of nature is hushed, and there comes a momentary darkness, the precursor of a perpetual light.

Stereograms of Mars, with a Chart of Mars on Mercator's Projection, and Descriptive Remarks on the Stereograms. By R. A. Proctor, B.A., F.R.A.S. London: John Browning, 111, Minories.

We learn, from Mr. Proctor's remarks, that these stereograms are photographs from the globe of Mars which Mr. Browning constructed in the spring of 1868, the edges of the pictures being softened by hand. Viewed in the stereoscope, they give a singularly real and solid figure of the planet, and will not only afford the astronomer an opportunity of studying Mr. Browning's globe, but will also enable him to test the accuracy of his own observations. In producing these admirable stereograms, Mr. Browning has rendered another important service to the science of astronomy.

The Quekett Microscopical Club.—We understand that Mr. Suffolk will repeat his course of lectures "On Microscopical Manipulation" in January, 1870. Gentlemen wishing for particulars can apply to the Secretary.

LABORATORY NOTES.

AN EXPERIMENT TO DEMONSTRATE INCREASE OF WEIGHT IN COMBUSTION.

There are two or three methods given in our text-books of demonstrating the increase of weight in combustion, and recently a novel one was described in the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin* (Chemical News, vol. xx., p. 71). This method consisted in burning iron filings attached to a magnet, the magnet and filings being hung over the pan of a moderately delicate balance. While preparing this experiment, another form of it occurred to me, and this I have found to answer admirably; it has, however, the disadvantage of requiring a supply of oxygen from a bag or gas-holder. The experiment is made thus:—A small patty-pan, or the lid of a tin box, is put in one pan of a balance and counterpoised; then a piece of iron wire, or a knitting pin, is placed on the pan, and this also weighed or counterpoised. The wire is now burnt before the oxy-hydrogen blowpipe, the patty-pan being held underneath the burning wire to catch the globules of iron oxide as they melt off. When the wire is burnt as far as practicable, the patty-pan with the globules of iron oxide and the portion of unburnt wire, is put into the scale-pan, and it will be found there is a considerable increase in weight, due to the oxygen which has combined with the iron.

C. J. Woodward, B.Sc.

Midland Institute, Birmingham,
December 20th, 1869.

MISCELLANEOUS.

Royal Institution of Great Britain.—The following are the arrangements for the Friday Evening Meetings before Easter, 1870:—

Jan. 21st. Professor Tyndall, LL.D., F.R.S., M.R.I.—"On Haze and Dust."

Jan. 28th. Professor Odling, F.R.S.—"On Professor Graham's Scientific Work."

Feb. 4th. Professor Ruskin, M.R.I.—"A Talk respecting Verona and its Rivers."

Feb. 11th. W. B. Carpenter, M.D., F.R.S., &c.—"On Temperature and Life in the Deep Sea."

Feb. 18th. William Kingdon Clifford, Esq., B.A.—"On Theories of the Physical Forces."

Feb. 25th. Colonel Sir Henry James, F.R.S.—"On the Results of the Excavations at Jerusalem, and on the Recent Survey of Sinai."

March 4th. E. J. Reed, Esq., C.B., Chief Constructor of the Navy.—"On Iron-clad Ships."

March 11th. Professor Sylvester, M.A., LL.D., F.R.S., —"On Chance."

March 18th. Peter W. Barlow, F.R.S.—"On the New Thames Tunnel."

March 25th. Professor Rolleston, M.D., F.R.S.,—"On History of the Fourth, Fifth, and Sixth Centuries in England, as Illustrated by Researches into the Modes of Sepulture then Practised."

April 1st. Professor Roscoe, F.R.S.

April 8th. Professor Huxley, F.R.S.

Examination of Petroleum.—We have received from the committee of the Mineral Oil Association, to which Dr. Paul is consulting chemist, a statement of results obtained in the examination of 75 samples of petroleum and other kinds of mineral oil purchased in the ordinary course from retail dealers in the Metropolis, which show—(I.) That one-half of the oil represented by these samples is petroleum within the meaning of the Act (31 and 32 Vict., cap. 56); (II.) That it gives off inflammable vapour at a temperature below that specified by the Act as the minimum for ensuring safety in the stowage and sale of such oil; and (III.) That there is still a very general and habitual disregard of the provisions of the Petroleum Act. A portion of each sample of oil tested has been preserved at the office of this Association.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, December 6, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Influence which Water Exercises upon the Double Decomposition of Saline Matter and upon the Thermic Phenomena by which these Decompositions are Accompanied.—M. Marignac.—This paper records the results of a series of experiments made with the view to ascertain, by the measurement of the thermal phenomena, what really takes place in double decomposition when rather dilute saline solutions are operated upon. When water is added to any solution of a salt or acid, a variation of temperature always takes place, which may be an absorption of heat or a disengagement thereof, but which does not exceed 0·2° for solutions of 1-10th, and becomes less for more dilute solutions. This rule is not, however, absolute, because the thermic effect caused by the dilution of sulphuric acid becomes greater with more diluted solutions. The figures 92, 135, 185, 255, express the caloric per equivalent (49), according to the state of the dilution, being 1-10th, 1-20th, 1-40th, 1-80th. The mixing of solutions of two salts which cannot decompose each other gives rise to thermic effects which are less marked. We regret that space forbids us now to enter into more details of this subject.

Reply to Remarks made by M. V. Regnault concerning Thermometers, and the Measurement of Temperature with these Instruments.—M. Bosscha.—The author answers the objections made by M. Regnault, and states that the paper of the latter does not teach anything certain on the indications of the thermometer between 0° and 100°; that M. Regnault considers that differences of 0·2° to 0·3° are insignificant quantities, which are too difficult to estimate, and may be neglected. The greater part of this paper is devoted to the question of the influence of peculiar kinds of glass on thermometers constructed with them.

Remarks on some Matters Relating to Spectrum Analysis.—M. Lecoq de Boisbaudran.—The author, in this paper, gives a preliminary account of the spectrum of the aureola emitted by the positive pole, that of the blue light of the negative pole, and that of the tail of fire (*trait de feu*). It being the author's intention to publish a memoir on this subject, we confine our abstract to this enumeration of contents.

Illumination of Transparent Substances.—M. Soret.—This paper contains, chiefly, observations on the labours made on this subject by M. Lallern, and there is attached to it a short note by M. Chevreul, who points out, in reference to observations made by the author as to the great difficulty of obtaining perfectly pure water, and the effect of that fluid upon glass vessels, that, as far back as the year 1811, he (M. Chevreul) found ammonia in all waters, however carefully distilled, and, besides this, he found it invariably to contain alkaline silicates, derived from its action upon glass, which is, even at comparatively low temperatures, acted upon by water. The eminent *savant* states that the bottles in use in his laboratory are made of green glass, which does not contain lead, and is better fit to resist the action of water, as well as of chemicals.

Researches on the Action of Contact (Catalytic Force of Berzelius).—M. Dubrunfaut.

Normal Quantity of Sugar contained in Wine.—M. Petit.—The author states that he has tested several samples of Bordeaux, Burgundy, Cahors wines, and wines produced in the Departments of du Cher, de la Loire, and de l'Indre, and found that the quantity of sugar contained therein varies from 5 to 0·5 grms. to the litre of wine. No sugar could be detected in old wines. The quantitative estimation of sugar in these fluids is done by the author in the previously decolourised wines (by means of filtration through animal charcoal), and treating the filtered liquid with the well-known Fehling reagent. The sugar may be obtained in the separate state by saturating the wine with lime-water, evaporating to dryness, and treating the residue with alco-

hol at 40° (95 per cent). The sugar is left, on evaporation of the alcohol, and may be used for controlling the Fehling test by means of fermentation.

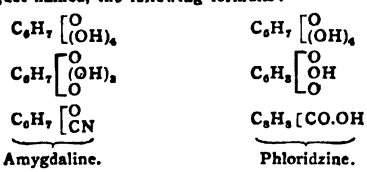
Chemical Composition of Fossil-Bones.—M. Scheurer-Kestner.—This very interesting and lengthy paper contains a series of results of analysis obtained by the investigation of fossil-bones of mammoth horses, and of bones of human skeletons belonging to the earlier centuries of our era. The author points out and proves that chemical analysis can decide the question of the respective ages of bones of various animals found mixed up together, and thus prove that these beings have not necessarily been contemporaneous with each other. This paper contains a large number of tabulated results of analysis made with the special view to careful estimation of the organic matter contained in the various bones. As instances, we quote the following, expressed in 100 parts:—Parietal human bone—Ordinary osseine, 3·1; osseine, soluble in dilute HCl, 12·3; water, 6·0; silica, 3·5; bone-earth (phosphate and carbonate of lime), 74·4. Fossil-horse—Ordinary osseine, 3·9; soluble osseine, 9·3; water, 6·8; silica, 0·3; bone-earth, 79·3. Mammoth bones—Ordinary osseine, 2·8; soluble osseine, 8·9; water, 5·7; silica, 12·4; bone-earth, 70·1. These bones were found in the Lehm, near Colmar, Bas-Rhin.

December 13, 1869.

This number contains the following papers relating to chemistry and allied sciences:—

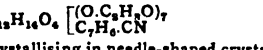
The Siderostat.—M. Leon Foucault.—This paper belongs strictly to astronomy, but the reason why we notice it is that it opens with a brief, but well-deserved observation, bearing testimony to the great value set by His Majesty the Emperor of the French upon science, and the aid given by him, and from his private funds, to promote the labours of scientific men in general, and in this special case to cause, at his expense, the continuation and publishing of the works of the deceased *savant* named at the head of this paragraph.

Constitution of Amygdaline and Phloridzine.—M. H. Schiff.—The author states that when he published a paper on arbutine, he briefly alluded to the subject of this paper, and gives, for the two substances just named, the following formulæ:—

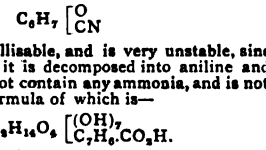


Amygdaline. Phloridzine.

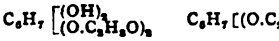
When amygdaline is treated with boiling anhydrous acetic acid, there is formed an heptacetylous amygdaline—



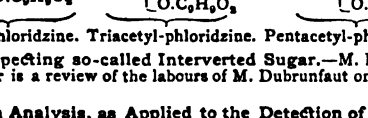
It is a solid substance, crystallising in needle-shaped crystals; amygdaline does not contain benzoyl, (C_7H_5O). When amygdaline is treated with aniline, which only acts upon the former at a temperature of between 160° and 180°, there is formed amygdaline-anilide—



This anilide is not crystallisable, and is very unstable, since, by the addition of boiling water, it is decomposed into aniline and amygdaline. Amygdaline does not contain any ammonia, and is not an amide of amygdalic acid, the formula of which is—



When anhydrous acetic acid acts upon phloridzine, three acetylated derivatives are obtained; one of these is crystalline, the two others are amorphous; they are represented by the following formulæ:—



Acetyl-phloridzine. Triacetyl-phloridzine. Pentacetyl-phloridzine.

Facts respecting so-called Interverted Sugar.—M. Maumené.—This paper is a review of the labours of M. Dubrunfaut on this subject.

Spectrum Analysis, as Applied to the Detection of Gaseous Substances, either when Single or Mixed.—M. Dubrunfaut.—This paper is not suited for useful abstraction; we may give it in full at a future period.

Analysis of the Morallon Kind of Emerald from the Muso Mines (New Granada).—M. Boussingault.—In the carburated schist of Iteco two kinds of emeralds are met with, designated by the appellation *canutillos*, crystallised emeralds always of great value, and *morallones*, amorphous and often fissured stones; of the latter kind the author has had a kilo. to experiment with akin to the first-named species; the colour of the latter varies from very deep green to very pale green, but the morallones are hardly transparent at all. Their sp. gr. is 2·64. On being submitted to strong heat, the loss per cent is 1·92. The analysis of this mineral has, at various periods, given rise, the author states, to some controversy. The older chemists considered that the colour was solely due to metallic oxides. But M. Loewy obtained a large proportion of carbonic acid when he ignited this mineral (the canutillo as well as morallon kind) in a current of oxygen; and he therefore concluded that the colour was due to organic matter. But M. Woehler and other German chemists saw that emeralds kept for an hour at the melting point of copper* did not change colour; and they detected the undeniable presence of oxide of chromium in this mineral. According to the author of this paper, the composition, in 100 parts, of the morallon emerald is:—Silica, 67·2; alumina, 19·4; glucina, 12·7; magnesia, 0·4; with traces of oxide of chromium and lime. Formula:—$Al_2O_3,2SiO_2+GlO_2,2SiO_2$.

Moniteur Scientifique, No. 312, December 15, 1869.

This number, chiefly filled with a copious index, does not contain any original papers.

Les Mondes, December 9, 1869.

This number contains the following original papers:—

Phosphorescence of the Sea.—M. Duchemin.—This phenomenon, the cause of which has given rise to much speculative discussion, has been thoroughly investigated by the author, who has been occupied with this subject for four years. The results arrived at may be summarised as follows:—The phosphorescence of the sea is solely due to the presence of myriads of very small infusoria (*Noctiluca miliaris*). These animalculæ emit light, produce phosphorescence, whenever they are agitated, either by mechanical means, by heat not exceeding 39°, for a temperature of 41° kills the animals, and after their death neither electricity, nor the action of cold or alcohol, or the addition of an acid to the sea-water, again brings about the phosphorescence. These infusoria are not killed by a strong degree of cold, which seems rather to excite the phosphorescence. An addition of 50 per cent of fresh water to the sea water does not affect the infusoria, but if they are placed in entirely fresh water they are killled. The addition to sea water of alcohol and any dilute acid for a moment greatly excites the infusoria, and a brilliant phosphorescence is the consequence; but the experiment is fatal to them. When the infusoria are kept in perfect darkness for more than a fortnight, they still preserve their faculty of phosphorescence. Electric currents do not kill these beings, which, according to the author, cause to those bathing in the sea sometimes a peculiar exanthema.

December 16, 1869.

Générateurs in explosibles (Steam-Boilers which cannot Explode).—MM. Belleville and Co.—This number contains the description, accompanied by several cuts, which merit the attention of all who have to work with steam, especially of high pressure.

Cosmos, December 4, 1869.

The number contains—

Properties of Vapours (Apparatus Bénévides).—M. Bénévides.—The apparatus, described and illustrated by a cut, is devised by the author with the view to prove the laws of ebullition, the phenomena of latent heat, the influence of temperature upon the tension of vapours, the mode of action of Giffard's injector, the cold produced by the expansion of very high pressure steam when blown off in the atmosphere, the action of steam as a motive power, and the transformation of the heat of combustion into mechanical force.

December 11, 1869.

Biography of Alexander von Humboldt.—Dr. C. Bruhns.—The author states that this work, of which he is the chief editor, will be published in the following manner:—The general scientific biography of the deceased eminent *savant* will be edited by MM. Avé-Lallemant, Dove, Loewenberg, and Foerster. The second section of the work will contain the following sub-divisions, to each of which the deceased contributed largely:—Meteorology and hydrography, Dr. Dove; physiology, Dr. du Bois Reymond; zoology, Dr. Carus; botany and botanical geography, Dr. Grisebach; geology and mineralogy, Dr. Ewald; geography, Dr. Peschel; astronomy and mathematical geography, Dr. Bruhns; natural philosophy and magnetism, Dr. Wiedermann; Humboldt considered as author, Dr. R. Gosche.

December 18, 1869.

Specific Gravity of the Water of the Black Sea.—M. Lapschine.—While the author, as commander of the Russian navy's corvette, *Lwitza* (*Lioness*), was engaged in taking soundings of the depth of the sea above named, he found, at latitude N. 44° 25′ 30″, longitude E. of Poulkowa, 7° 7′, the deepest place, amounting to 1020 toises

* According to the latest experiments made on this subject by Dr. van Riemsdijk, at the Utrecht Mint, pure copper, kept in a very slow current of pure and dry hydrogen, requires, for fusion, a temperature of 1330° C.

(1 toise = 6 feet and 6 and 9-10ths inches, English measure), the sp. gr. of the water at the surface of this spot was 0·013, while the water from the deeper portions of the sea varied in sp. gr. from 1·0151 to 1·0140. The figure 0·0130, just quoted, is exactly as in the original, but is, presumably, intended for 1·013.

Petroleum Sources near the Caspian Sea.—M. Meunier.—The existence of petroleum in this region of Asia has been known from a remote antiquity, but only of late has this material become utilised; and new borings, made according to the American system, have revealed the fact that, from a depth of 250 feet below the surface, petroleum is forced up so as to spout from 50 to 65 feet above the surface, and to yield quantities amounting to 19,000,000 lbs. annually, while 200,000 lbs. of solid paraffin are obtained from a kind of asphalte, very abundantly met with in this remote region.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, October, 1869.

This number contains the following original papers relating to chemistry or allied sciences :—

Bronze Powder.—Dr. Wagner.—After referring to the history of the first application of the scraps and waste of what is commonly called tinsel, or Dutch gold (none of it was or is ever made in the Netherlands; this industry is confined almost entirely to Bavaria), the author treats of the mechanical means whereby the metal is brought to leaf and powder. There are three chief alloys in use, which are designated by the name of the colour, the composition of these being, in 100 parts :—For the light shade—copper, 83; zinc, 17; for the deeper shade—copper, from 90 to 94; zinc, from 10 to 6; for deep copper-red, no zinc at all. Copper may be obtained in finely-divided state by the following chemical means :—By igniting a mixture of chloride of copper, carbonate of soda, and sal ammoniac; by precipitating a solution of acetate of copper by means of sulphurous acid; by decomposing suboxide of copper by means of sulphuric acid; by electrolysis of a solution of sulphate of copper; by precipitating a solution of the last-named salt by means of a bar of iron wrapped up in filtering paper or coarse cotton tissue; but all the metal thus obtained is hard and crystalline, and unsuitable for the purposes it is intended for as bronze powder. The author found that, when oxide of copper, such as is used for elementary organic analysis, is submitted, hot, to the action of the vapours of ligroine (a light petroleum oil, or spirit), it is obtained in an excellent condition, and 100 kilos. of oxide require, for reduction at red heat, only 8 kilos. of ligroine.

Manufacture of Alcohol from Indian Corn.—M. Bergsträsser.—This paper is of interest only to distillers in countries where Indian corn is grown; the material is very suitable for the purpose, and the refuse remaining after distillation is a valuable food for milch cows, on account of the large quantity of fatty matter it contains.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, July and August, 1869.

The papers on chemical subjects in these two numbers have been forestalled by having been published in other German periodicals, from which we abstracted them.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 143, 1869.

This number does not contain any original papers relating to chemistry or allied sciences.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, October, 1869.

This number contains the following original papers:—

The Doctrines of Modern Chemistry.—Dr. Koller.—This paper contains a very clear review of the doctrines of modern chemistry, as compared with that of some years ago. The contents of this paper are divided into sections with the following headings:—Atomic and molecular weight; type and radical theory; substitution; anhydrides of acids; anhydrides of bases; salts, normal, basic, and acid. The paper is not well suited for useful abstraction.

On Gelatinæ Medicatæ.—Dr. Husemann.—This paper relates entirely to the pharmaceutical preparation of medicated gelatine lozenges.

Lithoreactive.—M. Weiss.—The author states that a mixture containing 5 per cent of sugar molasses, or beet-root syrup, 15 per cent of milk of lime (one part of slaked lime to three parts of water), and 80 per cent of caustic soda lye at 34° Beaumé, sp. gr. 1·039, is the best and surest means of preventing, as well as of breaking-up and dissolving, steam-boiler incrustations, while, moreover, this mixture is perfectly innocuous as regards its action upon either copper or iron. The hardest water only requires 1 kilo. of lithoreactive upon 1800 litres. of water.

Antimonoide.—M. Lichtenberger.—Under this curious name, there is in use a mixture for absorbing the protoxide of iron, while that metal is to be welded in red-hot state. The mixture consists of 4 parts of iron filings or turnings, 3 parts of borax, 2 parts of borate of peroxide of iron, and 1 part of water. The powder is made in the following manner:—To a solution of 3½ parts of borax in water, as much chloride of iron is added as is sufficient to obtain a precipitate of insoluble borate of peroxide of iron; this precipitate is washed upon a filter to remove common salt. This having been done, there is added to the precipitate (previously, of course, put in a suitable vessel) a solution of 3 parts of borax, and this mixture evaporated nearly to dryness, when there is added to it 4 parts of clean iron filings or turnings. The whole is then strongly dried and heated to incipient red-heat, whereby a fusion takes place; and, after cooling, the mass is pulverised.

NOTES AND QUERIES.

Electro-Deposition of Copper upon Cast-Iron.—(Answer to "Histrix.")—Among the many treatises on electro-metallurgy the "Repertorium der Galvanoplastik und Galvanostegie, &c.," von A. Martin, published at Vienna, is one of the best, and contains very ample information on this subject. This work can be inspected at the Patent Office Library.

Specific Gravity.—(Answer to "C. H. Parkin.")—According to Twaddell's scale, 0 is equal to 1000, or the specific gravity of distilled water, and each degree is equal to 0·005; so that by multiplying this number by the number of degrees marked on the scale, and adding 1·0 the real specific gravity is obtained. There are published tabular, forms giving the specific gravity for every degree of Twaddell's hydrometer.

Knife-Edges for Balances.—(1) Is a balance with agate edges as delicate in its indications, and as prompt in its action, as one with steel edges? [A balance with agate edges is as delicate in its indications, and as prompt in its action, as one with steel edges.]

(2) Is a balance with agate edges more liable to get out of order? [It is not so liable to get out of order.]

(3) If there be an advantage in the agate above the steel, is it worth the increased cost?—W. H. D. [Steel rusts in a damp atmosphere, or if kept in laboratory. Agate edges are well worth the extra cost.]

Treatment of Oils for Machinery Purposes.—(Answer to "B. S.")—Oils for machinery purposes, and for lubricating generally, may be purified by agitating them with from 4 to 8 per cent of their weight of a caustic soda lye, sp. gr. 1·2. After twenty-fours' repose, the supernatant oil is decanted from the soapy sediment, thoroughly washed with pure cold water, left to repose, again decanted, and filtered, best through some animal charcoal, such as is used for the filtration of sugar syrups in sugar refineries, and through the woollen tissue, also in use in these establishments. This treatment renders the oils very suitable for the purpose intended, and is quite free from any action on the metals.

Glue and Gelatine.—In reply to the enquiry of "G. G.," he will find every information in the admirable articles "On Gelatine and Glue," in Dr. William Allen Miller's "Elements of Chemistry," where the subject is thoroughly treated. I just add a test for the goodness of glue, which I have found very valuable. Assuming that "that" is the best glue which will take up most water—Take 50 grs. of the specimen, and dissolve it in 3 ozs. of water in a a water-bath. When dissolved, set it by fo 112 hours, to gelatinise; then take a 1 oz. chip box, place it on the surface of the gelatine, and put "shots" into the box, till it sinks down to a "mark" on the outside. It will be found that, the stronger the glue, the more shots it will take to sink the box down so that the mark shall be level with the surface of the gelatine. In a trial with Mitchell's glue, which is made here, and is the finest I ever met with, 50 grs. of glue, dissolved and gelatinised, with 3 ozs. of water, supported, to the mark on the box, 6 ozs. of shots, at a temperature of 58° F. On trying the same experiment with best Russian isinglass, 50 grs., dissolved in 3 ozs. of water, supported 9 ozs. of shots, the temperature being the same. Russian isinglass, therefore, is one-third stronger than glue in gelatinising power; but, as Russian isinglass is worth £84, and best glue is worth but £3, the cwt., there is no fear that the former will ever supersede the latter.—Alfred Bird, Birmingham.

MEETINGS FOR THE WEEK.

Tuesday, 28th.—Royal Institution, 3. Prof. Tyndall, "On Light." (Juvenile Lectures).

Thursday, 30th.—Royal Institution, 3. Prof. Tyndall, "On Light." (Juvenile Lectures).

Saturday, Jan. 1st, 1870.—Royal Institution, 3. Prof. Tyndall, "On Light." (Juvenile Lectures).

TO CORRESPONDENTS.

*** *Owing to our weekly Enclycopædic List of Foreign Papers connected with Chemistry and Physical Science having so materially enlarged the Contents of the* Chemical News, *we are compelled to issue the Index as a Supplementary Number. It has been compiled with great care, and with our copious abstracts of all the important papers, may be said to form an English edition of the "Jahresberichte." With the commencement of our new volume we intend to improve the appearance of the* Chemical News *by printing it on paper of a much better tone and quality.*

THE CHEMICAL NEWS.

VOL. XX. No. 527.

CAUSE OF BRIGHT LINE ON PARTIAL-PHASE ECLIPSE PICTURES.*

By Professor HENRY MORTON.

DURING the progress of the eclipse of August 7th, I observed on the negatives, taken during the partial phase by the section of my party with which I had located myself, a decided increase in the opacity of the silver deposit in immediate contact with the advancing edge of the moon. When, after our return to Philadelphia, all the negatives taken by the other two sections were handed over to me, I found the same characteristic appearance, varying only slightly in degree, to distinguish all of them, and this had, of course, been noticed by those engaged in making the pictures. In fact, many remarks have been made upon this point, and some deductions drawn from it.

On the paper prints prepared from these negatives this local density produced a line of light in contact with the moon's limb.

An appearance similar to this had been observed by Professor Alexander, in the photographs taken during the eclipse of 1860, as also by Mr. De la Rue, and while ascribed by Professor Challis and Professor Alexander to a very rare lunar atmosphere, had been explained by Mr. De la Rue and the Astronomer-Royal, as a subjective effect.

The Astronomer-Royal had, moreover, shown, in papers published in the *Monthly Notices* of the Royal Society, 1863, Nov. 13, and 1864, June 10, that no such effect would be produced by a lunar atmosphere, were it present. He, therefore, very justly discards such a supposition, and, by satisfactory experiments, shows that the light line in *the prints under his examination* is an optical illusion, and not an existing fact.

These experiments, however, when applied to good prints of our pictures, did not show the same result, and, beside, the actual opacity of the negatives seemed to preclude the above explanation as one accounting for the *entire* effect.

I therefore made the following experiment:—I converted one of the solar pictures, taken soon after first contact, into a crescent, by pasting partly over it a dark circular piece cut from another print. This showed a faint line of light, such as results from contrast, and which was no doubt found in the pictures examined by the Astronomer-Royal.

I then had this artificial eclipse-picture photographed (through the kindness of Mr. James Cremer), when negatives were produced showing a dense deposit along the lunar edge, and giving prints which showed a bright line in the same place, far more decided than that seen in the artificial original.

It thus appears that the effect observed in these eclipse pictures, while not due to any lunar inflection of sunlight, is also not due to an optical effect of contrast solely, but is, in great part, due to a chemical action, which may be explained by what we know of the chemical reactions concerned in the production of a negative.

It is well known that the development of a negative depends upon the presence of free nitrate of silver in the film, and that a great strengthening or intensifying may be produced by re-immersion in the silver bath, and a second application of the developer. Now, in the present case, part of the plate representing the dark edge of the moon, and, therefore, not acted upon, furnishes a reservoir of nitrate of silver, imbibed by the collodion film, which, during the development, penetrates for a short distance into the portion representing the *luminous* area of the sun whose supply of free nitrate was exhausted by the reaction which occurred at the first moment when the developer was applied.

My conclusion, then, is, that while a certain effect in the paper prints is, and was on former occasions, due to "contrast," yet, in the present instance, the peculiar appearance of the negatives, and most of that seen on the prints, is the result of a chemical action such as I have described, and does not represent any celestial phenomenon. The *appearance* of a bright line in the same place which has been noted by several observers is, we believe, due simply to the contrast of the sharply-defined lunar edge, which produces the faint line above mentioned, in the artificial eclipse picture before described.

* Communicated by the Author.

ON THE

CONSTITUTION OF THE COMPOUNDS OF SODIUM.

By J. ALFRED WANKLYN.

II.

IN this paper I propose to consider the function of sodium in the common compounds of the metal, and to enquire how far the ideas derived from the study of its organic compounds mentioned in the former paper are applicable to its common, well-known inorganic compounds.

Viewed in these organic compounds, sodium appeared as the representative—not of hydrogen, but of nitrogen; the task before me is, therefore, to represent, if possible, the inorganic sodium compounds as modelled on the plan of the compounds of nitrogen.

As I have already stated on various occasions, common salt admits of being looked upon as a sodium compound of the second order of complexity, thus:—

Cl Na‴ — — Na‴ Cl

and obviously a similar device might be applied to other well-known sodium compounds, such as the numerous soda salts.

I do not, however, propose to avail myself largely of a hypothesis of this kind on the present occasion, and am able to represent the metal as *unduplicated*, and, at the same time, trivalent in most of the compounds in question.

The following list of formulæ will speak for itself:—

Caustic soda	Na'''	$\begin{cases} O'' \\ H \end{cases}$
Nitrate of soda ..	Na'''	$\begin{cases} O'' \\ (NO_2)' \end{cases}$
Acetate of soda ..	Na'''	$\begin{cases} O'' \\ (C_2H_3O)' \end{cases}$
Sulphate of soda ..	Na'''	$\left\{ \begin{matrix} O'' \\ -(SO_2)''- \end{matrix} \right. \begin{matrix} \\ O'' \end{matrix} \left. \right\} Na'''$
Acid sulphate of soda	Na'''	$\begin{cases} O'' \\ -(SO_2'')-(OH) \end{cases}$
Bleaching soda ..	Na'''	$\begin{cases} (OCl)' \\ Cl \\ H \end{cases}$
Hypochlorite of soda	Na'''	$\begin{cases} O'' \\ Cl \end{cases}$
Sulphuretted soda	Na'''	$\begin{cases} S'' \\ H \end{cases}$
Common salt.. ..	Na'''	$\left\{ \begin{matrix} Cl \quad Cl \\ \text{———} \\ \text{———} \end{matrix} \right\} Na'''$, or Na_2Cl_2
Anhydrous oxide of sodium ..	Na'''	$\left\{ \begin{matrix} -O- \\ \text{———} \\ \text{———} \end{matrix} \right\} Na'''$, or Na_2O

Sulphuret of sodium $Na'''\left\{\begin{matrix}-S-\\ \\ \\ \end{matrix}\right\}Na'''$, or Na_2S

Bromide of sodium $Na'''\left\{\begin{matrix}Br\ Br\\ \\ \\ \end{matrix}\right\}Na'''$, or Na_2Br_2

Iodide of sodium .. $Na'''\left\{\begin{matrix}I\ \ I\\ \\ \\ \end{matrix}\right\}Na'''$, or Na_2I_2

Amide of sodium .. $Na'''\left\{\begin{matrix}(NH)''\\ H\end{matrix}\right.$

Nitride of sodium $(Na_3)'''N'''$

The list might be indefinitely extended, so as to exhibit the constitution of a host of double chlorides, bromides, and iodides. I will, however, content myself with formulating the Nessler reagent :—

$$Na'''\left\{\begin{matrix}(HgI)'\\ I\\ I\end{matrix}\right.$$

and will leave the rest to the imagination of my readers, who will find no difficulty in comprehending that to the new theory belongs the merit of rendering account of the vast number of double haloid compounds containing the alkali metals, which, according to the prevalent notion that the alkali metals are analogues of hydrogen, are regarded as mere freaks of nature, and as much as possible put out of sight.

Reverting to the new formula for caustic soda :—

The fact that caustic soda is volatile is an argument in favour of taking a single rather than a duplicate formula for that substance. (Possibly it will be found that when chloride of sodium seems to volatilise it really undergoes change into trichloride of sodium and metallic sodium—a view which is in harmony with various facts, notably, with the extraordinary power of chlorine to facilitate the volatilisation of metallic chlorides.)

According to the new theory, the action of sodium on water is as follows :—

$$Na''' + \left.\begin{matrix}H\\ H\end{matrix}\right\}O = HNa'''\left\{\begin{matrix}O + H\end{matrix}\right.$$

According to the theory at present in vogue, this reaction is thus :—

$$Na' + \left.\begin{matrix}H\\ H\end{matrix}\right\}O = \begin{matrix}H\\ Na'\end{matrix}\left\{\begin{matrix}O + H\end{matrix}\right.$$

The new theory, therefore, represents sodium as doing more than twice the amount of chemical work that is done by the metal according to the old theory. Instead of displacing one atom of hydrogen, sodium really displaces two atoms of hydrogen, and also combines with one of the displaced atoms. Hence the extraordinary quantity of heat generated by the action of alkali metals on water.

The ordinary theory of caustic soda, as a member of the water-type, is beset with difficulties and inconsistencies of many kinds. Why should caustic soda be so active a chemical reagent as it is? If alcohol and caustic soda be both of them built on the water-type, why should the former be so inactive and the latter so very active.

The new theory renders account of the energy of caustic soda. According to it this substance is, in one-third of its structure, the hydride of sodium, and, therefore, naturally endowed with abounding energy.

Berthelot's splendid discovery of the synthesis of formiate of soda is beautifully in harmony with the new theory :—

$$CO + Na'''\left\{\begin{matrix}O''\\ H\end{matrix}\right. = Na'''\left\{\begin{matrix}O''\\ COH\end{matrix}\right.$$

The production of bleaching soda, and, generally, oxidation under the influence of alkalies, are quite natural changes suggested by the very formulæ of the new theory :—

$$Cl_2 + Na'''\left.\begin{matrix}O''\\ H\end{matrix}\right\} = Na\left\{\begin{matrix}Cl\\ (OCl)'\\ H\end{matrix}\right.$$

London, Dec. 24, 1869.

ON SOME

TECHNICAL APPLICATIONS OF THE SPECTRUM MICROSCOPE.*

By H. C. SORBY, F.R.S., &c.

(Concluded from p. 306.)

On Some Adulterations of Malt Liquors.

I HAVE made very many experiments in order to ascertain how far the spectrum method can be employed in detecting adulterations in beer. Many of the substances used are added in such quantities, and impart so little colour, that there seems to be no chance of discovering them by their spectra. I have chiefly directed my attention to those employed as substitutes for hops, such as picric acid, gentian root, calumba root, and the entire plant of *Ophelia chireta*, commonly known by the more simple name of chiretta. So far I have not been able to detect any difference between the colouring matter of gentian, or chiretta, and hops. They all give the same reactions and spectra with the various reagents, or at least so nearly the same that there appears to be no chance of detecting them in the presence of the colouring matter of wort or beer. Calumba root, however, contains two colours, one of which is quite different from any that should occur in genuine malt liquors. The exterior part of the root is yellow, and water extracts from it a bright yellow colour. The interior part is browner, and does not contain this yellow, but a browner colour, which also occurs to some extent in the outer layer. On evaporating the aqueous solution to small bulk and re-dissolving in alcohol, this brown colour is left insoluble, but the bright yellow colour remains in the alcohol in a curiously turbid condition. The brown colour appears to be identical with that found in liquorice, and could not be detected by any of the reagents; but the yellow colour may be recognised, if beer has been adulterated by a moderate amount of calumba root. When dissolved in water or alcohol it is a very clear, bright yellow, but gives no well-defined spectrum. Ammonia makes it slightly orange, and when dissolved in sulphuric acid, it is the same bright yellow as in water. Oxidising reagents, such as hypochlorite of soda, produce no change in weak acid solutions; but when added to the solution in sulphuric acid they alter it into a deep red colour, changed into an orange-yellow by excess. Deoxidising reagents, such as hyposulphite of soda, restore the deep red to the original yellow. The most useful test in connection with the various other colours already described is hypochlorite of soda gradually added to the solution in sulphuric acid. This first makes it a deep red, giving the spectrum 3 . . 4 - —, and the addition of a little more produces scarcely any further change; but when large excess has been added it fades to an orange, giving the spectrum 6 . - 7 —. The colouring matter of fresh wort treated in the same manner is not turned at all red, and though the colour of finished beer is changed to red in a very similar manner, yet, after so much hypochlorite has been added as to turn it deep pink-red, a very little more makes it pale yellow. We may take advantage of this circumstance to detect calumba root.

In examining any suspected beer, it, and a similar quantity of genuine, should be evaporated in separate dishes, so that the results may be more accurately compared. The presence of calumba root is first somewhat betrayed by the fact of the resin, which separates on evaporation, being abnormally yellow, and when the syrup is dissolved in alcohol, and the solution evaporated to dryness, the purified colour is decidedly brighter yellow than it ought to be. Taking, then, two experiment cells, so much of the colour of the genuine beer should be dissolved in one—in

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sulphuric acid—as to give a decided orange yellow, with a spectrum 5 . . 6 - - 7—; and in the other cell so much of the suspected material as to give a colour of about the same tint. In both cases, about one-fourth of the bulk of the liquid should be alcohol, so as to prevent the formation of any precipitate. Hypochlorite of soda should then be added very gradually, and in equal quantities to both, when at first both will change to red, having a pinker tint in the genuine. After so much has been added as to make both as dark as they can become, a little more will turn the genuine to a pale yellow, giving a spectrum 7 . . 8 - - 9—; whereas that containing calumba root will remain a fine red orange, with a spectrum 3½ . . 4½ - - 5—. If too large a quantity of the hypochlorite be added, the colour of the calumba root will change into a much paler yellow, scarcely differing from that in the case of genuine beer, and hence particular care must be taken to add it gradually, and in small quantities. By this means, the adulteration of beer with 2 ozs. of calumba root to the gallon may be detected with confidence; but much less than that would scarcely give reliable results, unless it were possible to examine the unfermented wort. The addition of the hypochlorite to genuine wort does not turn it at all red, and merely alters it to a pale yellow; whereas, if calumba be present, it turns it to a decided red.

Picric acid may be detected when present in no larger quantity than 1 grain to a gallon. When dissolved in water, it is of a bright yellow colour, and cuts off the blue end of the spectrum in a sufficiently well-defined manner, giving the spectrum 8½ . . . This is not changed by ammonia or citric acid, nor does hypochlorite of soda cause it to fade when added to an acid solution. The most striking change is that produced by the addition of sulphuric acid, which makes it so much paler that a couple of drops added to the aqueous solution in one of the small cells leaves it nearly colourless. In order to detect it in beer, about 1 oz. should be evaporated to dryness, and then re-dissolved in no more water than will make the solution sufficiently liquid to allow bubbles to rise readily through it. This should be introduced into a test-tube and agitated with ether, which dissolves out the greater part of the picric acid, but scarcely any colour, from genuine beer. Since it is very important to avoid contamination with any of the material not soluble in ether, it is well, in the first case, to use somewhat more than the bulk of the concentrated beer, and to transfer it to another *perfectly dry* test-tube, then agitate with a fresh quantity of ether and add it to the first, arranging so that the total amount of ether may fill a ½ inch test-tube to the depth of about 2 inches. After corking it up, it should be allowed to stand till quite clear, and till any particles not soluble in ether have adhered to the sides of the tube. The clear solution should then be poured off into another tube, water added so as to give a depth of about half an inch, and well agitated with the ether. After it has collected at the bottom, the ether should be removed by a pipette, the aqueous solution washed with a little fresh ether, and then evaporated to dryness. In the case of genuine beer the ether extracts scarcely any colour, and the greater part of this and the resinous matter afterwards remain in the ether, so that on evaporating the aqueous solution, which is scarcely coloured, a mere trace of a yellow colour is obtained, so free from resin that, when dissolved in water and a drop or two of alcohol added, we obtain a clear, very pale yellow solution, so pale that if one ounce of beer has been used, the spectrum is about 10 . . 11.—, changed to about 9 . . 10 - - 11 — by sulphuric acid. If, however, picric acid be present, the solution in ether is a decided clear bright yellow; the greater part of the colour is extracted from it by the water, and on evaporating to dryness more or less of a clear bright yellow is obtained. If as little as a grain per gallon were present, when dissolved in water with a drop of alcohol, a clear bright yellow solution would be obtained, giving the spectrum 8 . . . made much paler by the addition of sulphuric acid, which decolourises the picric acid, and merely shows the colour of the beer itself, which, if one ounce had been used, and all the product introduced into the experiment cell, would not be deeper than 9 . . 10 - - 11—, or very decidedly paler than what would be seen before the addition of sulphuric acid, if even less picric acid than one grain per gallon had been present in the beer.

I have not been able to discover any essential difference between the colouring matter of *Cocculus Indicus* and that of liquorice; and though it would be difficult to prove it in a positive manner, yet I think it very probable that a small quantity of this colouring matter is the cause of the brown colour of chiretta, and of the slightly brown tinge in hops. It would, therefore, be impossible to detect *Cocculus Indicus* in porter by means of its colouring matter, even if present in far larger amount than is ever likely to be the case.

Though the detection of turmeric in beer does not necessarily depend upon the spectrum microscope, yet the method employed is so closely related to our present subject that it may be well to describe it. The best test for its presence is the very strongly fluorescent character of the solution in benzol. The alcoholic solution is much less fluorescent. In order to be able to detect fluorescence and examine the spectrum of the dispersed light, I have found it very convenient to make use of cells about three-quarters of an inch deep, made out of moderately thick barometer tube, having an internal diameter of about one-sixth of an inch, cut square, and polished at one end, and melted up at the other, which is fixed into a small brass foot by means of black sealing-wax. On introducing a clear solution, covering it with a small piece of thin glass, illuminating the tube at the side by strong daylight, and looking down the axis, the liquid appears quite black, if it be not at all fluorescent, for no light is reflected from either the apparatus or the liquid; whereas, if fluorescent, it looks more or less opaque and of a colour depending on the nature of the substance. Such tubes can easily be placed on the stage of the microscope, and the spectrum observed, which, in some instances, is remarkable in showing one or more narrow bright bands.

In the case of turmeric, a very minute quantity dissolved in benzol gives a beautiful more or less blue-green fluorescence, with no special dark or bright bands. Half an ounce of the suspected beer should be evaporated to so small a bulk that it may occupy only about half an inch in the depth of a test-tube half an inch in diameter, and an equal amount of benzol added to it, with about an equal quantity of alcohol; since, without this last, the globules of benzol collect together with extreme slowness. After well agitating the whole, the tube should be set aside until the benzol has collected at the top, as a clear solution, which must then be introduced into one of the cells just described, by means of a pipette. In the case of pure beer, this solution is of a faint yellow colour, but is scarcely at all fluorescent. If no more than one grain of turmeric has been added to a gallon of beer, the fluorescence is so strong that it could not be seen to greater advantage, and even as little as one-tenth of a grain per gallon may be detected with confidence.

It will thus be seen that the spectrum method of study serves to throw considerable light on some of the changes that take place in the process of brewing, and would also enable us to detect the presence of some adulterations; but, at the same time, it would always be requisite to bear in mind that it is possible that some of the colouring matters I have described may themselves become altered when kept in solution for a considerable time.

Adulteration in Drugs, &c.—Mustard.

I now proceed to describe the detection of adulteration in a variety of substances. Having just explained the method to be employed when the presence of turmeric is suspected, it may perhaps be well to mention now all that need be said on that substance. Its presence may easily be detected in nearly all the ground mustard sold in the shops; and, as far as I am able to judge from the intensity

of the fluorescence, the amount varies from about one-third to one-half per cent.

The natural seeds contain a yellow colour soluble in water, which is the same as that found in many yellow leaves; another yellow colour, insoluble in water, but soluble in alcohol, which corresponds with the xanthophyll of yellow leaves; and there is also often present a small quantity of chlorophyll in the imperfectly ripe seeds. The powdered mustard should be digested in alcohol, about an equal quantity of water added, and the solution filtered. On agitating with benzol this rises to the top, with the colour of the turmeric in solution, which can be easily detected by its strong green fluorescence. Chlorophyll, if present, would give a red fluorescence, and by transmitted light, a spectrum with well-marked absorption bands.

Rhubarb.

The same process may be successfully employed in the case of rhubarb; and as small a quantity of tumeric as 1-10th per cent may be detected in no more than 2½ grains of rhubarb. There is not the least difficulty in distinguishing, by this means, inferior pale rhubarbs coloured by turmeric, so as to resemble those of the best quality.

The detection of small quantities of gamboge, added to increase the purgative action of these inferior kinds, is not so easy, and requires some care, especially in the presence of turmeric. The suspected powder should be placed on a small filter, and so little alcohol added as will give a few drops of clear solution, which would contain a comparatively large amount of the very soluble gamboge, and but little of the less soluble colour of the rhubarb itself. This alcoholic solution should then be agitated with bisulphide of carbon, and the supernatant alcoholic solution removed by means of a pipette and blotting-paper, and the solution in the bisulphide evaporated to dryness. This would contain a colour peculiar to the different kinds of rhubarb, and, perhaps, also turmeric and gamboge. If a small quantity dissolved in benzol gives the green fluorescent solution, turmeric is present; and, in order to detect the gamboge, it would then be requisite to re-dissolve in alcohol and add a little nitric acid, which so changes the colour of the turmeric that it is no longer removed by agitating with bisulphide of carbon; whilst the gamboge remains unchanged, and is abstracted by it from the alcoholic solution. After separating this, evaporating the bisulphide to dryness, and re-dissolving in alcohol, a small quantity of an alcoholic solution of iodine should be added, and then excess of ammonia, a little sulphite of soda, and a drop of water, to make it dissolve. This ensures the complete removal of any free iodine that may remain after the addition of ammonia.

In the case of pure rhubarb, this solution, when sufficiently but not too strong, has a decided pink colour, giving no well-marked absorption band in any part of the spectrum, but transmitting the blue rays very considerably better than the green; whereas, when gamboge is present to the extent of 2 per cent or upwards, the yellow colour due to it cuts off the blue light, and the solution is orange colour. The spectra are as follows:—

Pure rhubarb	4…8	9..10—11—
Rhubarb, with 2 per cent of gamboge	4…9	—10—
" " 4 "	4…8	—9—
Gamboge alone	7..8	—9—

In very many other cases, bisulphide of carbon is a most valuable reagent to separate different colours. An excess should be agitated with the alcoholic solution, when it sinks to the bottom, carrying with it the whole of some colours, and leaving the alcohol quite colourless. Other colours are only partially removed; whilst others are not abstracted in the least degree. These last are usually, but not always, those soluble in water; whereas, those easily removed are usually, if not always, insoluble in the liquid.

The cells for the examination of the spectra of solutions in bisulphide of carbon, ether, chloroform, or benzol, should be fixed to the glass plate by means of a mixture of glue and honey, made so as to be quite stiff, but yet to melt when warmed. Cells so cemented must be washed out with the liquids named above, and never with water or hydrous alcohol. The spectra of colours dissolved in the bisulphide are far more characteristic than when dissolved in any other liquid. So far, I have met with between two and three dozen different vegetable colours soluble in this reagent. The absorption bands are much farther removed from the blue end, when they occur in that part, so as to be far more distinct; and their position is not subject to variation from any change produced by evaporation, as in the case of ordinary alcohol, which may thus become more weak, and give the bands in a very different situation.

On the whole, the spectra are so characteristic and uniform that different colours, soluble in bisulphide of carbon, may usually be recognised in a very satisfactory manner by means of the spectrum of that solution alone; and this is fortunate, since such colours can seldom be distinguished by their behaviour with reagents. The dried colour must be dissolved in fresh bisulphide, since, when it separates from the alcohol, it contains some of that liquid in solution, which alters the position of the bands. As an illustration of what may be done, I give a few examples:—

Cheese.

Cheese of orange colour was digested in bisulphide of carbon, the solution washed by agitating with alcohol, and evaporated to dryness. On re-dissolving in alcohol diluted with a little water, a considerable amount of oily matter was separated; and, after evaporating the clear solution to dryness, and re-dissolving in bisulphide of carbon, it gave the spectrum 5½ 7½, which corresponds exactly with that of red annatto.

In all such experiments, it is requisite to use deep experiment cells (I use one 2½ inches deep), so that the amount of the bisulphide may be large in comparison with that of the oils, since the presence of much oil causes the bands to lie nearer the blue end, and thus interferes with the production of the characteristic spectrum.

Butter.

Treating yellow butter in a somewhat similar manner, I obtained the spectrum 6 7½. This differs entirely from that in the case of cheese, and corresponds with the spectrum of the colour of the exterior orange portion of carrots; but I am not quite certain whether this might not be derived from carrots eaten by the cows, though I am more strongly inclined to believe that it had been artificially introduced to increase the colour of the butter.

The difference between the spectra of the above-named colours and of various others closely allied to them will be better understood from the following table. In all cases they are those of the solutions in pure bisulphide of carbon:—

Red annatto	5½	7½
Exterior of carrot and the skins of several kinds of fruit	6	7½
Xanthophyll of many yellow leaves and flowers, and of the interior of carrots	6½	8
Colour of the petals of *Brassica* and of many other yellow flowers	6¾	8¾
Orange-yellow colour of turnip roots, and of the flowers of *Eryssimum Perofskianum*	5½	6¾ 8¾

It will thus be seen that these spectra differ from one another so much as clearly to show that they are due to different substances, which are often further distinguished by their different behaviour with bisulphide of carbon and alcohol, some being almost entirely, and others only very partially removed from the alcoholic solution by that reagent, so that they may be separated when two occur

mixed, as is not uncommon in some leaves and flowers. By first agitating the alcoholic solution with a little bisulphide, and washing this with alcohol, one may be procured nearly pure; and then, after agitating with a second small quantity of bisulphide and removing it, the other colour may be obtained nearly pure by evaporating the alcoholic solution to dryness, and dissolving the residue in bisulphide, which leaves indissoluble any of those numerous colours soluble in water which so commonly occur in leaves, flowers, and fruits. It is now nearly two years since I determined the existence of a considerable number of distinct substances, of which at least eight have lately been described by Dr. Thudichum.* under the general name of *leuteine*. I think that this new name can only be looked upon as something like the old term *xanthophyll*, as hitherto inaccurately employed for a whole series of yellow colours, some of which correspond with some of those included under *leuteine*. If it were thought desirable to have a generic name, the term *leuteine* might indeed be employed; but I must protest against the idea that the substances described as such by Dr. Thudichum are one single colouring matter. Some of their properties are indeed very similar, but that is often the case with those substances which give closely connected spectra, even when other facts show that they are entirely distinct, for there seems to be a sort of correlation between optical characters and chemical reactions; but this is no reason why we should confound together substances giving absorption-bands in distinctly different positions in similar solutions.

Saffron.

The adulteration of saffron with the sliced petals of the yellow crocus could easily be detected, even in a solution, by means of the remarkable spectrum of the latter, when the product of the action of bromine is deoxidised by sulphite or hyposulphite of soda. To the alcoholic solution of the colours soluble in water an aqueous solution of bromine should be added very gradually, until, after having become quite pale, it is made slightly yellow by the addition of more. Excess of ammonia and a little sulphite of soda should then be added. In the case of pure saffron the liquid remains almost or quite colourless, whereas ammonia first turns the colouring matter of the crocus to a red, which soon becomes yellow, and then sulphite of soda changes it to a remarkably fine red, which is highly fluorescent or red-orange colour, the spectrum showing a bright narrow band at about 3½. That of the transmitted light is very characteristic, and shows an excellent absorption band at 4½. On adding citric acid the colour becomes red-pink; it is still highly fluorescent, but of more yellow tint than before, the bright band being raised to about 4, and the absorption band in the spectrum of the transmitted light is raised to 5½: but the addition of hydrochloric acid destroys both the fluorescence and the absorption band. The only colour that I have met with analogous to this is one which occurs in the yellow flowers of several plants allied to the common wallflower (*Cherianthus Cheiri*), but the bands are in distinctly different positions. The production of the fluorescent colour is apparently due in both cases to deoxidisation, for even proto-sulphate of iron has the same effect as sulphite or hyposulphite of soda. If too much bromine be added, this change does not take place; but by a little care a small amount of the petals of the yellow crocus could be detected in a considerable quantity of saffron. The presence of safflower might be recognised by a similar process, but not so decidedly. After adding bromine and ammonia, it remains distinctly yellow, but gives no absorption band, whereas pure saffron is thereby quite decolourised.

Aloes.

I have tried a number of experiments in order to ascertain whether it would be possible to detect the adulteration of the socotrine aloes with the hæpatic, but have not yet succeeded in discovering any satisfactory method. It appears as if both contain the same general colouring matter, but the socotrine a second in addition. When ammonia is added to the alcoholic solutions, the socotrine gives a more orange colour than the hæpatic, and the green part of the spectrum is more absorbed; so that, when compared side by side, the spectra are—

Socotrine	4 ..	6½ — —
Hæpatic		6½ — —

It would, therefore, be possible to distinguish them from one another, or to detect the socotrine in the hæpatic, which is, however, the reverse of what would be likely to occur, since inferior things are not often adulterated with better.

Adulterations by means of Cochineal and Magenta.

Cochineal may be best detected in the tincture of roses by adding to the aqueous solution bicarbonate of ammonia and sulphite of soda. This changes the colour of the pure tincture to a very pale yellow, but that adulterated with cochineal to a light red. The spectra are somewhat thus:—

Pure tincture	8 ..	9 — — 10—
Adulterated with cochineal	3½ ..	7 — — 9—

The presence of magenta might be recognised by the spectrum of the solution in its natural state. The pure tincture shows no narrow absorption band in the green, whereas magenta gives a very distinct one, situated at 5 of my scale. In the case of the syrup of damsons and similar fruits, magenta may be detected, when in very small quantity, by agitating a dilute alcoholic solution with chloroform. If so much alcohol be added as only to partially dissolve the chloroform, scarcely a trace of the magenta is left in the alcoholic solution; and the characteristic spectrum can be easily seen by examining the chloroform, which scarcely abstracts any other colour. Ammonia produces no change in a solution of magenta in dilute alcohol; but the absorption band is immediately removed by a mere trace of sulphite of soda.

It would scarcely be a correct description of the facts to say that cochineal may easily be *detected* in pink-coloured confectionery, since, in some cases, its spectrum is seen to almost as great advantage as in any condition without any preparation, and it could generally be recognised with very little manipulation.

No doubt many other applications of methods similar to those I have described would present themselves to any one engaged in technical inquiries. I do not for one moment pretend to have exhausted the subject. I have merely examined various questions in order ascertain what methods might be employed with advantage; and I trust that the cases described above will, at all events, facilitate the application of this kind of qualitative analysis to practical questions; for I have met with many who were anxious to employ it, but had not sufficient time at command to make the preliminary experiments, which are so very necessary in all such inquiries.

Uses of Aluminate of Soda.—The white opaque glass (semi-porcelain) of which the French gas-globes are often made is manufactured in various ways. Hitherto, kryolite (fluoride of aluminium and sodium) has been found to answer best for the manufacture of the opaque white glass, but it seems now destined to be supplanted by aluminate of soda. In the application of the latter, no fluorine compounds are evolved which act very much on the substance of the melting pots. 1 cwt. aluminate of soda is equal to 1¼ cwts. kryolite and 1-10th cwt. calcined soda in the mixture for making that kind of glass. The aluminate, as manufactured by kryolite-soda makers, is quite free from iron, which is never the case with kryolite itself. Other applications of the new manufacture are in dyeing and print works; as a mordant in soap making, where white and heavy soap is required; in precipitating dyeing lakes, &c. Very likely the applications of this product will become more numerous as it becomes better known.

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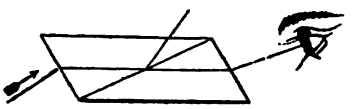
ON MICROSCOPICAL MANIPULATION.*

By W. T. SUFFOLK, F.R.M.S.

(Continued from p. 302.)

By an ingenious process, invented by Mr. Nicol, a crystal of Iceland spar is divided in the direction indicated in Fig. 35, and joined together again with

Fig. 35.†

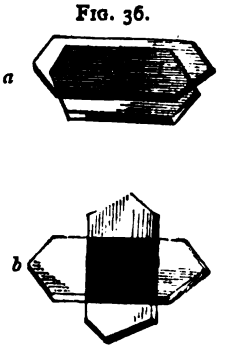


Canada balsam. This causes one of the rays to be so much refracted that it is thrown altogether out of view, and only one polarised ray is transmitted. This contrivance is known as the *single image* or *Nicol prism*, and is the means of polarisation most generally adopted for microscopical purposes.

Polarisation may also be effected by the use of thin slices of a mineral known as *tourmaline*. This crystal, when cut into thin plates parallel to the axis of the crystal, allows only the undulations in one plane to pass, the other being stopped. The cause of this action is, as yet, not understood. If two plates of tourmaline are superposed, and held before a strong light, it will be found that the light is alternately transmitted and stopped at every 90°, when one of the plates is rotated.

The same effect is produced, in a much greater degree, by using a pair of crystals of sulphate of iodoquinine, more commonly known as *Herapathite*, from its discoverer, the late Dr. William Bird Herapath. This salt is prepared by a tedious and complicated process, and described in a communication by Dr. Herapath to the Royal Society, and quoted in many microscopical works ("Micrographic Dictionary," second edition, p. 590). The obtaining of large regular crystals fit for polariscopes is a matter of great difficulty; and, unless the student is very expert in chemical manipulation, he is recommended not to attempt it. Small specimens fit for

Fig. 36.



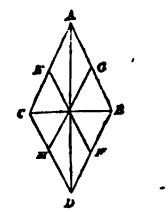
microscopical examination may, however, easily be made. This salt is the most powerful polarising agent known. If two crystals are superposed with their axes parallel (Fig. 36, *a*), light is readily transmitted; but, if the axes are crossed, as in *b*, the parts covering each other become perfectly opaque to transmitted light. This can easily be seen in a slide of the crystals mounted as a microscopical object, as some of the crystals are sure to be in this position.

The sky possesses the power of reflecting polarised light. If the observer stands with one shoulder directed to the sun, so that he faces a point 90° from it, and looks at a white cloud through a Nicol prism, he will find that the light reflected from the cloud is polarised, and that, as the prism is rotated, the cloud will alternately appear as a white cloud on a dark ground and a dark cloud on a light ground.

The effects here described may readily be seen without the special apparatus of mirrors, &c., by any one who has a microscope fitted with the usual polarising apparatus of two Nicol prisms. If the larger one, *the polariser* be put in its place below the stage, and the mirror so arranged that the light of a lamp or daylight be directed through it, it will be found, upon rotating the prism in its fitting, that no change is apparent, as the light, although polarised, is transmitted in every position of the prism. If the small prism, or *analyser*, be now put in its place, either over the object-glass or, better still, over the eye-piece, it will be found that the alternate transmissions and stoppages of light take place. If a film of *selenite* be now placed on the stage of the instrument, it will be found that the light will be coloured; and, when one of the prisms is rotated 90°, the colour will change to the complementary tint. For instance a film that transmits red light in one position of the prisms will transmit a green of such quality as to produce white light, were the two mixed. Blue would produce orange every quarter revolution; and so on through the other tints of the spectrum. Similar effects are produced by using films of mica, and all crystals possessing the property of double refraction.

To understand these changes of colour, it will be necessary to describe the direction of the axes of a crystal of selenite, which is represented in Fig. 37,

Fig. 37.*



A, D and C, B being the position of the depolarising axes, and E, F and C, H that of the optic axes. To understand the powers of these regions of the crystal, it will be necessary to try another experiment, which, although more advantageously shown with a large polariscope, can be done sufficiently well under the microscope. Let the film of selenite be so mounted as to be capable of rotation. If the stage of the microscope is capable of concentric rotation, no further contrivance is necessary. If the prisms now be arranged for the production of colour, and the selenite be slowly rotated, it will be observed that the colour gradually disappears. On continuing the rotation, it increases, and regains its intensity. If the amount of rotation is noticed, it will be found that the disappearances coincide with the position

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

† Pereira on "Polarised Light," published by Longmans and Co.

* Brooke's "Natural Philosophy," published by Churchill.

of the optic axes, E, F and G, H, and while the greatest intensity of colour is produced when the plane of polarisation passes through the depolarising axes, A, D and B, C. If the analyser be removed, no colours are to be seen; it is therefore evident that the analyser plays some important part in the production of these colours.

The selenite, being a doubly-refracting crystal, causes the ray of polarised light to be divided into two, which are, as usual, polarised in perpendicular planes, and, reaching the eye together, no colour is produced; but, if the analyser is added to the combination, the colourless image is broken up into two coloured ones, one only of which reaches the eye. If, instead of the Nicol prism, a contrivance known as the "double-image prism" be used, which will transmit both rays, but in a separate condition, the two images of complementary colours will be seen at once, and, if, by a suitable contrivance, they be made partially to overlap, the part where they join will be white, produced by the union of the two complementary tints.

The position of the optic axes may be easily observed in the corpuscles of starch and other polariscope objects which produce the well-known black cross, which indicates in a very marked manner the situation of these axes of no polarisation.

The apparatus employed for the examination of microscopical objects by means of polarised light consists of a *polariser*, *analyser*, and *retarding plate*.

The *polariser* is generally a Nicol prism, mounted so that it may be conveniently rotated; this is attached, by a suitable fitting, either beneath the stage, or, in large microscopes, to the sub-stage movement.

The *analyser* varies, being, according to circumstances, a Nicol prism, tourmaline, or Herapathite. The *Nicol prism* is the form of analyser generally used, and can be placed either over the eye-piece or within the body of the microscope above the object-glass; in the first position it has the advantages of being easily rotated, and of not interfering seriously with the definition of the magnified image; but, on the other hand, when used with any eye-pieces but those of the lowest power, it cuts off the margin of the field and reduces it to an injurious extent; this is owing to the prism by its thickness causing the removal of the eye to some distance from the eye-glass, although the Nicol prism, when intended for use as an analyser, is generally made as short as is consistent with efficient action. When the prism is placed within the body, it does not cut off any portion of the field, but the interposition of a dense substance, like Iceland spar, impairs the corrections and consequently the definition of the object-glass, and also causes some loss of light. It is much to be regretted that in many of the smaller microscopes no other provision is made for the placing of the analysing prism. When the binocular is used with polarised light, the analyser can be placed in no other position, and it is usually mounted in a short adapter so contrived that the prism can be easily rotated. It is well to have the means of using the analyser in both positions, that choice can be made of that best adapted to the kind of observation in progress; if very perfect definition is of less consequence than a field of full dimensions, as in viewing such objects as crystals, in which very little detail is to be seen, then the prism in the body may be employed with advantage; but should the formation of an image very perfect in its details be required, then the prism must be placed over the eye-piece.

Tourmaline, when it can be obtained of sufficiently pale colour, makes a good analyser, from its thinness it can be used over deep eye-pieces without cutting off the field; good stones are, however, scarce, and consequently expensive, as many light coloured specimens do not polarise well. The tourmaline is mounted in a brass cap similar to the one placed on the eye-piece, which is to be removed and the analyser substituted. Crystals of *Herapathite* polarise more powerfully, and are much lighter in colour than the palest specimens of tourmaline, and when they can be procured make very perfect analysers; they are extremely thin and do not interfere at all with definition, and are to be preferred in all delicate investigations. Where, however, total freedom from colour is a necessity, the Nicol prism, notwithstanding its other disadvantages, must be used.

The *retarding plate* or *selenite film* is commonly mounted, either on card, like an ordinary slide, or else in a brass plate, with a ledge to keep the object from slipping off; this is a very disadvantageous form, as the selenite cannot be rotated, while in a perfect polarising arrangement, every part, object included, should be capable of rotation. The most convenient and useful arrangement of selenites is that devised by the late Mr. Darker, in which a series of three discs are by combination made to give as many as thirteen different tints. In large microscopes having a substage, these selenites can be mounted so as to be capable of rotation either together or separately, and also allowing the selenites to be used or not, without disturbing the arrangement of the object on the stage.* These advantages have hitherto been confined to large microscopes; but Mr. Baily has so mounted a set of Darker's selenites for the author that they can be placed upon the stage in the ordinary manner, and at the same time allow of discs being added or withdrawn and rotated, without interfering with the object; the thickness of this stage plate is no more than is necessary to contain the three discs and allow them space to move, and all complicated machinery is dispensed with. The arrangement of Darker's system of selenites appears, at first sight, somewhat complicated, but is not so in reality, and the power of obtaining such a variety of coloured backgrounds is a very great advantage. The series consists of three discs, marked $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{2}$, which figures represent a certain amount of retarding influence upon the wave of polarised light and consequent colour production. Besides the figures just mentioned, each disc has engraved upon its mounting the mark P.A., meaning positive axis; when the selenites are superposed with these marks coincident, the effect is, that the power of one selenite is added to that of the other; for example, if the $\frac{1}{4}$, and $\frac{1}{8}$ discs are so placed, the power will correspond to the sum of the numbers, viz, $\frac{3}{8}$, but if the $\frac{1}{4}$ be turned round 90° then the $\frac{1}{8}$ will have only a power of $\frac{1}{8}$, the crossed position of the $\frac{1}{4}$ subtracting instead of adding its power to the $\frac{1}{8}$. The experiments with selenite films already described will have prepared the student to understand the cause of this; it will be recollected that the colour disappeared when the selenite passed through one of the optic axes

* A very perfect polarising apparatus is described by Mr. J. J. Field, *Journal of the Quekett Microscopical Club*, vol., p. 215; also in *Monthly Microscopical Journal*, vol. ii., p. 276.

of the selenite, provided the position of the prisms remained the same. If, instead of moving the disc 90° it be only moved 45°, the effect will be to neutralise; instead of giving a negative power the result will be the same as if the selenite were withdrawn. The following table, of the arrangement of Darker's selenites may be useful to those who possess the series. The colours vary somewhat in different sets, so the table must be made out by each observer for his own use. The colours in the following table are those given by Richard Beck in his work on "The Microscope:"—

	Prisms at right angles.	Complementary tint.
1. ¼ by itself ..	Very light lavender.	Straw colour.
2. ¾ − ¼	Darker do.	Light yellow.
3. ¾ by itself ..	Deep blue.	Light maize.
4. ¾ + ¼	Very light blue.	Orange.
5. ¾ − ¾ − ¼ ..	Lake.	Emerald green.
6. ¾ − ¾	Deep blue.	Bright yellow.
7. ¾ − ¾ + ¼ ..	Light green.	Light purple.
8. ¾ − ¼	Light plum colour.	Pea green.
9. ¾ by itself ..	Blue green.	Salmon.
10. ¾ + ¼	Green yellow.	Mauve.
11. ¾ + ¾ − ¼ ..	Pink light.	Green.
12. ¾ + ¾	Light pink.	Deep green.
13. ¾ + ¾ + ¼ ..	Very light red.	Stone green.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, December 14, 1869.

J. P. Joule, LL.D., F.R.S., &c., President, in the Chair.

Sir Charles Lyell, Bart., LL.D., D.C.L., F.R.S., &c., and Henry Clifton Sorby, F.R.S., F.G.S., were elected Honorary Members of the Society. Mr. Robert Routledge was elected an Ordinary Member.

Mr. William Boyd Dawkins, F.R.S., exhibited some old mining tools, brought over by Mr. Bauerman from the turquoise mines of the promontory of Sinai, consisting of a stone-hammer and rude splinters of flint. The turquoises occur in a bed of a quartzose mottled sandstone, in Wady Sidreh and Wady Maghara, in joints running, for the most part, north and south. They were worked, according to the evidence of the hieroglyphic inscriptions on the rock, by the Egyptians from the third to the thirteenth of the dynasties mentioned by Manetho. In and around the workings there are still the tools with which they were carried on. Innumerable splinters of flint, with their points blunted and rounded by use; stone-hammers, some of which are broken; and rounded pebbles, with a concavity on either side, caused by the friction of the thumb and finger, charged with particles of sand; and segments of small wooden cylinders, lie together. The flint flakes exactly coincide with the grooves in the rock made in the excavation, and evidently have been blunted by such use. The fragments of wooden cylinders are believed by Mr. Bauerman to have been portions of the sockets into which the flakes were fitted. The round pebbles were probably used for driving the rude chisel formed by the flint inserted into the wooden socket; while the large stone-hammers were used for breaking up the rock. There was no evidence that metal of any kind was used in the work. Mr. Bauerman also satisfied himself that the hieroglyphs were cut with implements similar to those used in the mining. This discovery is very important, because it opens up the question as to what tools the Egyptians used in working their wonderful monuments of granite and syenite. If it were worth their while to conduct turquoise mining with flint flakes in the Sinaiitic promontory, and if they used the same tools in the hieroglyphs that fix the date of these mines (and of this there can be no reasonable doubt), it is very probable that they employed the same means for the same end elsewhere, and that, to say the least, a part of their marvellously minute sculpture in Egypt has also been wrought with flint. There is no evidence that they were acquainted with the use of steel. Iron and bronze are not hard enough for the purpose. The minute and delicate sculpture left behind by the Mexicans, which can be proved to have been worked with stone tools, adds to the probability of this view.

NOTICES OF BOOKS.

A Pharmacopœia, Including the Outlines of Materia Medica and Therapeutics, for the Use of Practitioners and Students of Veterinary Medicine. By Richard V. Tuson, F.C.S., Professor of Chemistry and Materia Medica at the Royal Veterinary College. London: John Churchill and Sons. 1869. Pp. 311.

The preface informs us that this work is designed for the use of practitioners and students of veterinary medicine. The agents are arranged in alphabetical order, according to the plan adopted in the "British Pharmacopœia," and are treated of under the following heads:—(1) Latin Pharmaceutical Name; (2) English Pharmaceutical Name; (3) Synonyms; (4) Compositions; (5) Mode of Preparation; (6) Characters and Tests; (7) Actions and Uses; (8) Doses; (9) Modes of Application; (10) Incompatibles; (11) Antidotes; (12) Preparations. This work bears evidence of the progress of scientific veterinary medicine in this country, which has hitherto in this respect remained backward as compared with France, Belgium, and Germany, and last, but not least, with the Netherlands, where scientific veterinary medicine has replaced rude and clumsy empiricism and quackery since the middle of last century. Veterinary medicine requires in its practitioners an amount of tact and spirit of patient observation, which in some respects makes it as difficult a practice as that of the diseases of infants and young children. The book of Professor Tuson is carefully written, and is a valuable addition to the literature of the subject. It will be valued not only in this country, but in many parts of Europe, as well as in that great portion of America where the English language is widely used and known. The composition of bodies is expressed in modern atomic weights, a table of which, together with a list of the old ones, is appended. At page 24 we meet with Aër Chlori; it would have been better to write chlorium gasiforme, or gas chlorium. Aër is strictly limited to the atmospheric air we breathe, and if it is desired to express the state of aggregation of chlorine at all, it is best, we think, to use the word *gas*, first introduced by the well known Van Helmont; instead of *aërial* we should prefer gaseous. We notice with pleasure the excellent tables of weights and measures of the metrical system, and the relation of these weights to the British and *vice versâ*. The index to veterinary medicines, *arranged according to their actions and uses*, has been very carefully compiled, and it is a very useful feature therein that the Greek and Latin words have been properly explained and their derivation made clear. The work is well executed, being printed in a very clear and legible type, and has been carefully revised, since we have not, on perusing it, met with any clerical errors. We recommend the book with pleasure, and hope that veterinary medicine may rise, as it ought, in the estimation of scientific, and especially medical men, who should consider that the veterinary physician may exercise, by the proper attend-

ance to his calling, a great influence for the general public good. Seeing that that portion of *Police Science*, as Dr. H. von Mohl calls it, which is termed "Administration de la Sûreté et Salubrité Publique," is in this country an ill-defined and rudely digested chaotic mass, one cannot wonder that sufficient care has not been taken to assign to veterinary medicine its proper place and the social status it really deserves.

A Treatise on Asiatic Cholera. By C. MACNAMARA, Surgeon to the Calcutta Ophthalmic Hospital. London: John Churchill and Sons. 1870.

As may be expected from a medical man resident in the endemic area of cholera, this work contains very valuable information on a most difficult subject. From Section II., "On the Historical Account of Cholera," we learn what the Sanskrit writers have recorded on this subject; the translation given of an *historia morbi* by Susruta is highly interesting, and the more so to those who ever have witnessed patients attacked by Asiatic cholera, since they can hardly fail to observe the great resemblance this description bears to the reality; and from the vestige of a remote antiquity it would also appear that the disease has been in existence sporadically long before our era. The earliest notice of the existence of cholera in Hindostan, from the pen of a European, occurs in the "Lendas da India," by Gaspar Correa, in the year 1503; the entire chapter on the history of this disease is in every way interesting, and contains a great deal of hitherto unknown, or, at least, not well collected information. The section on the geographical distribution of cholera, and that on the bearing of meteorological influences upon the spread of this disease is also very valuable; the etiology of cholera is lucidly treated of, and the theories of Messrs. Bayer, Pettenkofer, Farr, and others, discussed in a clear manner. The value of the work is enhanced by the addition of several official reports, well executed maps, and statistical diagrams. As is usual with these publishers, this work is brought out in excellent style, and is a most valuable addition to the bibliography on this subject.

LABORATORY NOTES.

SULPHURETTED HYDROGEN APPARATUS.

THE following apparatus for the production of sulphuretted hydrogen, will perhaps be found useful.

It consists of a wide-mouthed bottle, A, fitted with a sound cork having two holes; through one hole a short glass tube (similar to the tube through which air is blown in a common wash-bottle) is passed, projecting into the bottle about ¼ inch.

A second smaller bottle, B,—one that can be lowered into A—is also fitted with a cork having two holes; through one a U-shaped tube is passed in such a manner that one end may touch the lower surface of the bottle A, and the other that of B, when one bottle is within the other. That portion of the tube which touches the lower surface of the big bottle should be of india-rubber, to prevent breakage.

The small bottle, with its cork and tube, should now be lowered into the bottle A, and through the remaining hole in each cork a tube is to be passed which shall project into the bottle B, about ¼ inch. All the holes through which the tubes pass should be lined with india-rubber tubing to render them air-tight.

To use the apparatus, remove the large cork, and it will necessarily bring away with it the small bottle with its tubes. Fill the bottle B, about three-fourths with acid sulph. dil.; fix its cork. Now place in the bottle A some sulphide of iron in lumps. Lower the small bottle till it rests on the bottom of A. Fix in the large cork. If air be now blown through the tube projecting into the bottle which contains the acid, the contents will be forced through the U-shaped tube into the bottle A, where it will mix with the sulphide of iron, and the gas will be evolved, which will escape through the tube opening into A. When sufficient gas has been obtained, by blowing through the tube by which the gas is escaping, the acid will again be forced through the U-shaped tube into A, and all action will cease. Powdered sulphide of iron must not be employed, because it would be carried back with the acid into the small bottle, where the action would be continued.

C. J. H. WARDEN.

Dec. 20th, 1869.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, December 20, 1869.

This number contains the following papers and memoirs relating to chemistry or sciences allied thereto:—

Distribution of Potassa and Soda in Plants.—M. Peligot.—This is a third paper on this subject, and the author treats in it the question whether plants have the faculty of absorbing the alkaline substances contained in the soil, and also whether they can, by any choice, assimilate the salts of potassa in preference to those of soda. The main points of this paper are:—(1) That soda is met with in plants in several distinct forms; this alkali is taken up by the radicles, penetrates into the tissues of the plants, and is found among the mineral matter left after incineration of the same. (2) In some marine plants, soda exists, in the form of salt water, in the sap which fills the tissues of these succulent vegetables. (3) All plants grown sufficiently near the sea-board contain chloride of sodium dispersed over their surface; but the presence of this salt in the ash of such plants does not imply that this salt has contributed to the development of the plants. The discussion of this paper gives rise to a statement of facts observed last autumn by M. Elie de Beaumont, who says that, while staying at Canon, Department du Calvados, and at a distance of 23 kilometres (about 14·3 English miles) from the coast, he observed that, during a severe W.S.W. gale, the leaves of the trees of that part of the country were, so to say, burnt up; and he ascribes this to the pulverised sea-water dust carried inland by this gale, proving that at a great distance from the coast sea-salt may be mechanically brought over.

Observations on the Communication of M. Soret, bearing upon the Illumination of Transparent Substances.—M. Lallemand.

Formation and Duration of Induced Currents.—M. Blaserna.—Both physico-mathematical papers.

Electro-Motor Force Developed by Platinum when it is brought into Contact with Various Liquids.—M. Gaugain.—The contents of this paper may be resumed as follows:—(1) That unplatinised platinum which is left for some time in an acid liquid is gradually modified, and thus becomes, after a shorter or longer lapse of time, more positive than it was at the moment of its first immersion. (2) That platinised or unplatinised platinum which is placed in an alkaline fluid becomes gradually more negative.

Researches on the Preparation and Purification of Sulphide of Carbon.—M. Sidot.—The chief results of the experiments made on this subject by the author prove that a full red heat is the best temperature for obtaining the largest quantity of sulphide of carbon from a given weight of sulphur in the state of vapour and charcoal. At a low red heat (*rouge sombre*), as well as at a bright red heat (*rouge vif*), the formation of this sulphide takes place, but the quantity obtained is by far smaller. As regards the purification, the author first re-distils the raw product, then shakes the distillate up with mercury, until the latter becomes black, and this operation is so long repeated as the metal is affected by the fluid, or, rather, by any sulphur dissolved in it. Sulphide of carbon thus purified is freed from the fœtid odour it generally has, and exhibits a smell of ether.

Composition of the Skin, the Modifications it undergoes by Tanning, and the Fermentation of Tannin in the Tan-Pits.—M. Müntz.—The author has investigated the skins and hides during the three principal stages of the operation of tanning it. In fresh

state, skin contains from two-thirds to three-fourths of its weight of water; dried at 110°, it becomes one of the most hygroscopical substances we are acquainted with. The immediate analysis of skin led to the following results for 100 parts:—Cellular tissue not acted upon by boiling water, 3·080; fatty matter, 1·058; mineral matter, 0·467; substances capable of forming gelatine, 95·395. During the tanning, the substance fixed in and upon the skin is not tannin, but a derivative thereof, which may be denominated tanning material (*matière tannante*), which differs from tannin in this respect—that it contains less oxygen and more hydrogen. The fermentation going on in the tan-pits takes place with exclusion of air, and gives rise to the formation of lactic, acetic, gallic, formic, and carbonic acids, while a small quantity of propionic acid is also formed.

An Error Committed in Saccharimetrical Estimations.—M. Maumené.—We intend to give a full translation of this paper at a future period.

Annalen der Chemie und Pharmacie, November, 1869.

This number contains the following original papers and memoirs:—

Balsam of Peru.—M. Kraut.—Among the substances originally only known and used in pharmacy, very few have given rise to such a number and such protracted investigations as the balsam just alluded to. The author of this paper has tried to reconcile, and bring into proper harmony, the researches of all his predecessors, and states that the oil of balsam of Peru (the cinnameine of Frémy) has been prepared by him by acting upon the original balsam with a mixture of ether and soda-lye containing about 4 per cent of soda. The ethereal solution is first washed, next deprived of the ether by distillation, and then the oil dried at 120° in a current of pure and dry hydrogen. By fractional distillation, this oil may be separated into three different portions:—(*a*) boils at 200°, and yields, on analysis, C_7H_8O; is converted into benzoic acid, without any evolution of carbonic acid, by the action of chromic acid. (*b*) boils at 300°, contains 79·09 per cent C and 6·0 per cent H, and was found to be benzoate of benzyl ether, a colourless fluid of the consistency of sweet oil of almonds; sp. gr. at 18·5°, 1·114; formula, $C_7H_7.O.C_7H_6O$. (*c*) boils at the boiling-point of mercury; sp. gr. at 23°, 1·050; this substance is cinnamate of benzyl ether—formula, $C_7H_7.O.C_9H_7O$; the dark-coloured residue remaining in the retort is styracine. When the oil, as originally obtained, is submitted to the action of caustic potassa dissolved in alcohol, and the resulting substances examined, the author found:—(*a*) Cinnamate of ethyl ether, $C_2H_5.O.C_9H_7O$; (*b*) benzyl alcohol, boiling at 206·2; sp. gr. at 19°, 1·0465; not solidified at −18°; formula, $C_7H_7.O.H$. The chief constituents of balsam of Peru are—Free cinnamic acid, resin, and the benzyl ethers of benzoic and cinnamic acid.

Action of Sulphurous Acid upon Chloride of Platinum.—M. Birnbaum.—When platino-chloride of ammonium is mixed with an aqueous and concentrated solution of sulphurous acid, care being taken to keep the latter in excess, a yellow solution is obtained which, on being concentrated by evaporation on a water-bath just to the point of crystallisation, and then further dried over sulphuric acid, after addition of some sulphurous acid solution, yields a salt—

$$Pt\left\{\begin{matrix}Cl\\HSO_3\end{matrix}\right\}+2NH_4Cl.$$

This compound is to be considered as a monobasic acid, a view fully confirmed by the fact that, instead of the two molecules of chloride of ammonium, chloride of potassium, or sulphate of ammonium can be taken up. The potassium salt is—

$$Pt\left\{\begin{matrix}Cl\\KSO_3\end{matrix}\right\}+2NH_4Cl.$$

When ammonio-chloride of platinum is treated with acid sulphite of ammonium, a salt is obtained—

$$Pt\left\{\begin{matrix}HSO_3\\HSO_3\end{matrix}\right\}+2NH_4Cl+H_2O.$$

Octyl Compounds.—M. Schorlemmer.

Derivatives of Propan.—M. Schorlemmer.

Action of Bromine upon Ether.—MM. Ladenburg and Wichelhaus.—The action of bromine upon compounds of organic origin is either a substitution or an addition, so that the halogen is found instead of H, or has become incorporated with the organic molecule, which is thereby saturated; but this action is not that commonly met with when bromine acts on the substances known as "ethers," since very frequently the halogen in these instances combines with the radical (*e.g.*, C_2H_5), and, while displacing O, causes an intrinsic change of the molecule. The authors have investigated this action more especially with Kay's ether (orthoformic ether), boiling between 146° and 148°; bromine acts upon this fluid, even at the ordinary temperature, forming bromide of ethyl and carbonic ether. The reaction of the halogen upon this orthoformic ether is represented by the following formula:—

$$2CH(OC_2H_5)_3+Br_2=$$
$$=2BrC_2H_5+CO(OC_2H_5)_2+CHO(OC_2H_5)+C_2H_6O.$$

The authors also investigated the action of bromine upon orthocarbonic, ethyl-glycolic, and ethyl-lactic ether.

Contribution to Our Knowledge of Selenium.—M. Rathke.—This monograph is divided into the following sections:—The allotropic modifications of selenium, and their relation to those of sulphur; sulpho selenium; seleno carbon; selenium-xanthogenic acid; experiments made for the purpose of forming selenium-tetrethyl and sulpho-tetrethyl; ethyl-selenious acid.

Preparation of Zinc Ethyl.—M. Rathke.—The preparation of zinc ethyl, according to the method suggested by MM. Beilstein and Alexeyeff, is rendered of far easier execution when there is added to the mixture of iodide of ethyl and zinc (with or without the addition of sodium amalgam) a small proportion of zinc ethyl from a former operation. The author states that the formation of zinc ethyl is thereby accelerated to such an extent as to admit of the entire operation being finished, by the aid of the heat of a water-bath, in half an hour. When 2 grms. of zinc ethyl are added to 100 grms. of iodide of ethyl, the action becomes sometimes so violent as to necessitate the withdrawal of the source of heat and cooling of the retort wherein that action takes place.

Di- and Tri-Chlorobenzoic Acid.—MM. Beilstein and Kuhlberg.—Tenth portion of a memoir on the subject of "Isomerism of the Benzoic Group." This portion of the monograph is divided into the following chapters:—Dichlorobenzoic acid from dichlorotoluol; dichlorobenzoic acid from benzoic acid; trichlorobenzoic acid from trichlorotoluol; alcohol of trichlorobenzoic acid, $C_6H_2Cl_3.CH_2HO$; trichlorobenzoic acid from benzoic acid.

Action of $SbCl_5$ upon Chloride of Toluol.—MM. Beilstein and Kuhlberg.—The authors, referring to a treatise they published in vol. CL. of this periodical (title not given), now state that when chlorine is passed into boiling tetra-chlorotoluol chloride, $C_6HCl_4.CH_2Cl$ (boiling-point, 296°), they obtained, by the fractional distillation of the products of this reaction, a fluid boiling at about 285°, from which, at 84°, crystals were deposited, which proved to be pentachlorobenzol, $C_7H_2Cl_5$. When trichlorotoluol is acted upon by chlorine at its boiling-point, the authors obtained therefrom a substance (tetrachlorobenzol) boiling at 240°, fusing at 140°; formula, $C_7H_2Cl_4$.

Toluchinones.—M. Borgmann.—Trichlorotoluchinon, $C_7H_4Cl_2O_2$, a solid substance exhibiting yellow-coloured crystals; difficultly soluble in cold, but more readily in boiling, alcohol; very readily soluble in ether and chloroform; and readily decomposed by heat. Trichlorotoluhydrochinon, $C_7H_4Cl_2O_2$.—Needle-shaped crystals, readily soluble in alcohol, and fusing at 212°. Biacetyltrichlorotoluhydrochinon—

$$C_6Cl_2\left\{\begin{matrix}CH_3\\O.C_2H_3O\\O.C_2H_3O\end{matrix}\right.$$

a crystalline solid, readily soluble in alcohol and ether, and fusing at 114°. Biethyltrichlorotoluhydrochinon—

$$C_6Cl_2\left\{\begin{matrix}CH_3\\O.C_2H_5\\O.C_2H_5\end{matrix}\right.$$

also a solid substance, fusing at 107°. Monochlorotoluhydrochinon-bisulpho acid—

$$C_6Cl\left\{\begin{matrix}CH_3\\OH\\OH\\(SO_3H)_2\end{matrix}\right.$$

a salt soluble in hot water, insoluble in alcohol, and crystallising in leafy-shaped crystals.

Supplementband, vol. vii., No. 1.

This number contains the following original papers and memoirs:—

On Mellitic Acid.—M. Baeyer.—From this very lengthy essay, we quote that mellitic acid was discovered by M. Klaproth, in a mineral called honeystone. The author refers, at some length to the researches made by MM. Wöhler, Liebig, Erdmann, Gerhardt, and others on this subject, and then states that, according to his own investigation, the most simple formula for mellitic acid is $C_{12}O_{12}H_6$; that is to say, that this acid is a benzol all the H of which has been replaced by the carboxyl group, CO.OH. This is fully proved by the fact that, when mellitic acid is decomposed in contact with soda-lime or lime at a high temperature, benzol and carbonic acid (carbonate of lime) are formed. This treatise is divided into the following sections:—Mellitic acid, which the author says is a sexbasic acid and a rare substance, since the mineral from which it is obtained is very sparingly found. Hydromellitic acid, $C_{12}O_{12}H_{12}$, also a sexbasic acid, obtained from mellitic acid by the action of sodium amalgam. Action of sulphuric acid upon hydromellitic acid, assisted by heat; the products of this action are carbonic acid, a quadribasic, and a tribasic aromatic acid—viz., isopyromellitic acid, $C_6H_2(CO_2H)_4$; and trimesinic acid, $C_6H_3(CO_2H)_3$. Hydroisopyromellitic acid, $C_{20}O_8H_{10}$. Hemimellitic acid, $C_9O_6H_6$. Pyromellitic acid, $C_{10}H_6O_8$. Hydropyromellitic acid, $C_{10}H_{10}O_8$. Action of sulphuric acid and heat upon hydropyromellitic acid. Trimellitic acid, $C_9H_6O_6$. Isohydromellitic acid, $C_{18}H_{18}O_{18}$. Action of sulphuric acid and heat upon isohydromellitic acid. Action of bromine upon hydromellitic acid. Benzol-carbon acids. Hydrobenzol-carbon acids. It should be mentioned that this paper is only the first part of the author's essay on this subject.

Indol.—M. Baeyer.—Indol can be obtained from indigo by two different methods—viz., by causing the vapours of oxindol to pass over heated powdered zinc; or, also, by heating, with the same metal, the yellow material obtained when indigo-blue is treated with tin and hydrochloric acid. From the author's statement, it appears, however, that indol is a substance which is difficultly prepared and very difficult to obtain in pure state. When pure, indol is a solid substance, soluble in water, crystallisable, fusing at 52°, and readily soluble in alcohol, ether, and hydrocarbons; it is a weak base, not forming salts very readily. Composition, in 100 parts:—C, 82·05; H, 5·98; N, 11·97. Formula, C_8H_7N. Indol is characterised by the peculiarity of producing red-coloured combinations. When the alcoholic solution of indol is mixed with hydrochloric acid, it tinges a piece of fir-wood placed therein cherry-red in a few minutes. The author states that

M. Kühne has found indol in the products of decomposition of the pancreatic juice.

New Method of Formation of Monobromacetic Acid.—Dr. Gloeckner.—The author describes, in this essay, a series of experiments made with bromethylen-bromide, $C_2H_2Br_2$, and obtained, especially by treating this substance in sealed tubes exposed to a higher temperature, and containing various substances (as, for instance, BaO, KaO, and water) along with the bromethylen-bromide, among other products, monobromacetic acid.

Action of the Haloids upon the Metallic Derivatives of some Carbon Compounds.—M. Bunge.—The author prepared silver succinimide by boiling pure succinimide with water and oxide of silver. The silver succinimide thus obtained was treated with iodine, and, by means of many carefully executed operations, crystals of pure iodide of succinimide were obtained. This compound is very prone to decomposition, especially when heated, since it cannot bear 100° without very perceptible alteration; it is readily soluble in aceton and water, but difficultly in alcohol and ether. The author obtained, with difficulty, some other compounds, but not in state of sufficient purity for analysis, and failed to substitute cyanogen for the atom of nitrogen which is combined with H in succinimide. Some experiments were also made relating to the action of vapours of bromine upon dried benzoate, oxalate, and succinate of silver; the products hereby obtained are bromobenzoic acid, bromide of silver, and succinic acid.

Zeitschrift für Chemie von Beilstein, No. 22, 1869.

The number contains the following original papers:—

On Cytisin.—Dr. A. Husemann.—This paper contains the account of some additional experiments on this subject, which was briefly abstracted by us from another paper (see CHEMICAL NEWS, vol. xx., p. 36). The formula of cytisin is $C_{20}H_{27}N_3O$; it fuses at 154·5°, and can be sublimed when the heat is properly regulated. The nitrate of this base, $C_{20}H_{27}N_3O,(HNO_3)_2+2H_2O$, is the only salt which crystallises well; it is soluble in water and dilute alcohol; its taste is far more bitter than that of the base itself. The hydrochlorate of cytisin, $C_{20}H_{27}N_3O,4HCl+3H_2O$, is a salt very soluble in water. With the following acids, cytisin yields deliquescent salts:—Sulphuric, phosphoric, formic, acetic, propionic, butyric, valerianic, oxalic, and tartaric. With the chlorides of platinum, gold, and mercury (bichloride), cytisin yields double salts, which can be obtained in crystalline state. Among the large number of reactions discovered by the author for the easy detection of this base, the most sensitive are:—A solution of iodine in iodide of potassium produces, even in the most dilute solutions of cytisin, a deep red-brown precipitate, which is at first amorphous, but becomes, when left standing, converted into beautiful transparent deep-red prisms. Bromine water produces, even in solutions containing only 1-150000th part of the base, a distinct cloudiness, and in more concentrated solutions, an orange-coloured precipitate. Chlorine water does not yield any precipitate or cloudiness at all. Cytisin is found in all parts of the well-known tree, *Cytisus laburnum, L.*, except in the wood; the ripe seeds contain a large quantity of this very dangerous substance, which is a poison, whether it be ingested into the alimentary apparatus or subcutaneously applied. From 3 to 5 decigrms. of cytisin, subcutaneously applied, will kill a large dog within half an hour.

On Isomeric Chlorotoluidines.—M. Wroblevsky.—When pure chlorotoluol is gradually treated with nitric acid (sp. gr., 1·475), the author succeeded in obtaining, after having twenty-six times repeated a fractional distillation, two nitro products, one of which boils at 245°, and the other at 253°; the sp. gr. of the former was found to be 1·307, and of the latter 1·325, both at 18°. The product boiling at 243° is designated by α, the product boiling at 253° by β; the formulæ are—α, $C_7H_6Cl(NO_2)$; β, $C_7H_6Cl(NO_2)$. Both bodies having been treated with fuming sulphuric acid, yield a sulpho acid; the baryta salt of that acid of the α kind is a readily crystallisable salt, rather difficultly soluble in water—formula, $(C_7H_5ClNO_2.SO_3)2Ba+4H_2O$; the baryta salt of the β kind is so readily soluble in water that it is impossible to obtain it in pure state. α chlorotoluidine, obtained from α $C_7H_6Cl(NO_2)$, by the action of Sn and HCl, is a fluid, sp. gr. at 20°, 1·185, boils at 238°, is not solidified at −14°, insoluble in water, and readily soluble in alcohol; β chlorotoluidine is a solid (when pure), crystallising in large foliated crystals, fuses at 38°, boils at 241°, almost insoluble in water, and readily soluble in alcohol. Both these substances yield crystallisable salts.

Contribution to the Knowledge of Sulpho-Nitrogen Acids (Schwefelstickstoffsäuren).—MM. Claus and Koch.—When neutral aqueous solutions of nitrite of potassa and sulphate of potassa are mixed together, there will be at first formed a cloudiness, or turbidity, shortly followed by the appearance of a quantity of needle-shaped crystals, while the solution becomes, simultaneously, distinctly alkaline to test paper. If concentrated solutions of the salts referred to are mixed, the reaction is finished in a couple of minutes, and the mass has become a thick magma, while, at the same time, the temperature of the mixture sometimes rises to 80°. The authors have investigated this salt, and studied many of its derivatives; the salt alluded to, tetrasulphammoniate of potassa (*tetrasulfammonsaures-kali*)—

$$K_4HNS_4O_{12}+3H_2O=4\left(S\begin{matrix}OK\\O_3\end{matrix}\right)^1\}.NH_3,$$

is formed according to the following equation:—

$$4(K_2SO_3)+KNO_2+3(H_2O)=5(KHO)+K_4HNS_4O_{12}.$$

The authors describe, at length, the mode of preparation and analysis of trisulphammoniate of potassa—

$$3\left(S\begin{matrix}OK\\O_3\end{matrix}\right).NH_3,$$

obtained from the foregoing salt by the action of water upon it according to the formula—

$$4\left(S\begin{matrix}OK\\O_3\end{matrix}\right).NH+H_2O=3\left(S\begin{matrix}OK\\O_3\end{matrix}\right).NH_3+KHSO_4,$$

of a disulphammoniate of potassa—

$$3\left(S\begin{matrix}OK\\O_3\end{matrix}\right).NH_3+H_2O=2\left(S\begin{matrix}OK\\O_3\end{matrix}\right).NH_3+KHSO_4.$$

The preparation and mode of analysis of these salts require very delicate manipulation.

Chemical Constitution of Pyroxiline (Gun Cotton).—Dr. Gintl.—The author states that when gun cotton, and also the collodion wool, are thoroughly moistened with concentrated sulphuric acid, after having been previously washed with water, so as to remove any matters present therein soluble in water, and left quietly standing in a well-closed suitable vessel, the substances will be dissolved and converted into a colourless, syrupy fluid. When this fluid is cautiously diluted with water, so as to prevent any increase of temperature, and next saturated with carbonate of baryta, and the excess of the latter salt, along with the sulphate of that base, are removed by filtration, there is obtained a perfectly colourless fluid, which, after having been evaporated *in vacuo* over sulphuric acid, leaves a gum-like mass, containing crystals of nitrate of baryta. The gum-like matter consists chiefly of the baryta salt of ligno-sulphuric acid (*holzschwefelsäure*), which may be obtained in free state by very cautious and careful removal of the baryta, by means of dilute sulphuric acid. Ligno-sulphuric acid was first discovered by Braconnot.

NOTES AND QUERIES.

Electrotyping Cast-Iron with Brass.—Can any of your readers kindly inform me if there is any known method of electrotyping cast-iron with brass?—E. B.

Dissolving Resin in Water.—Will any of your readers kindly inform me whether there is any process by which ordinary resin can be dissolved in water without losing its clearness and natural orange colour; and, if so, what the process is?—J. MILTON.

Analysis of Nitrous Oxide.—(Reply to "Veritas.")—Happening to possess a copy of Roscoe's "Elementary Chemistry," and looking over the article "Nitrous Oxide," I find he does not assert that, after analysis of the gas by potassium, in a bent tube over mercury, the products, after combustion of the metal in the gas, are nitrogen and potassium hydroxide, KHO; but he says that the products of the combustion are solid potassium oxide, or potash, and nitrogen.—W. K.

Native Carbonate of Baryta.—Will any of your readers kindly inform me, through the medium of your valuable paper, what are the principal applications of native carbonate of baryta, and what is about its market value?—A READER.

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MEETINGS FOR THE WEEK.

MONDAY, Jan. 3rd.—Medical, 8.

TUESDAY, 4th.—Royal Institution, 3. Prof. Tyndall, "On Light." (Juvenile Lectures).

WEDNESDAY, 5th.—Pharmaceutical, 8.

THURSDAY, 6th.—Royal Institution, 3. Prof. Tyndall, "On Light." (Juvenile Lectures).
—— Royal, 8.30
—— Royal Society Club, 6.

FRIDAY, 7th.—Geologists' Association (Anniversary), 7.30.

SATURDAY, 8th, 1870.—Royal Institution, 3. Prof. Tyndall, "On Light." (Juvenile Lectures).

TO CORRESPONDENTS.

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